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Electrical Construction and Maintenance

ELECTRICAL CONTRACTING

SEPTEMBER · 1947

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fluorescent ballasts

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CABLE
LAMPS
STARTERS
LAMPHOLDERS
for
DEPENDABILITY
in fluorescent lighting

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With which is consolidated Electrical Contracting, The Electragist and Electrical Record...Established 1901

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering installations, repairing, maintenance and management, in the field of electrical construction and maintenance.

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FENWAY PARK, BOSTON

On June 13, 1947, Fenway Park, home of the Boston Red Sox, saw its first game under lights. 1120 G-E Type L-69 floodlights blanketed the field with an even flood of light that measured 200 foot-candles. Thus Fenway Park became second to none in lighting brilliance among the ball parks of the world.

Fenway Park is equalled only by Yankee Stadium, lighted to 200 foot-candles last year with the identical type of G-E floodlights. And Crosley Field, Cincinnati—the first major league park to play night baseball—has more than doubled its floodlight level this year by installing 510 Type L-69 floodlights in place of open-type floodlights which had served for 12 years.

this is the Floodlight...

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simplifies installation *Saves time in installing and replacing lamps* Lamp is inserted from above without disturbing reflector position. *Saves time in assembling* No separate door glass to handle. *Saves time in adjustment* By use of scale, or rifle sights and aiming charts, can be accurately and quickly adjusted during daytime.

that

saves in maintenance *Less cleaning required* Dirt and bugs are sealed out by front glass which is spun-sealed to reflector, and by gasketing the removable socket housing. *Easier to clean* While cleaning the door glass is all that is normally required, cleaning of reflector can be accomplished without tools and without disturbing the adjustment.

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delivers more light Highly efficient reflector design delivers approximately 10 per cent more light per watt than other types. And with sealed construction and specially processed aluminum reflector, efficiency remains high.

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THE G-E TYPE L-69 FLOODLIGHT—used in lighting Fenway Park, Yankee Stadium, and in the relighting of Crosley Field—is equally suitable for smaller baseball fields, for football fields, or for any other sports areas. In its first year, it has been selected for over 50 installations of these types. Bulletin GEA-4835 gives full information. Apparatus Dept., General Electric Co., Schenectady 5, New York.

SEPTEMBER . . . . *at a Glance*

Power

In mid-August electric power production was running at a rate of 4.85 billion kilowatt hours a week. That's close, very close to last December's peak. This December's peak will break all records. By this year end we'll have a total of 51,600,000 kw. capacity to serve a load expected to reach 50 million kw. Local power shortages are inevitable but will probably be handled by temporary expedients involving little if any public inconvenience. Utilization growth, however, exceeds new capacity this year by 400 percent. There is no sign of any immediate reduction in this ratio. Practically all of the statistical load increase since the war is in commercial and domestic uses. It has occurred with negligible sales effort. We haven't begun to sell planned lighting, electric heat, air conditioning or high wattage domestic appliances. What real sales work in any of these fields would do to power production curves can only be imagined. New generating capacity will be coming on the lines in time. The next few months, however are going to be critical. It's going to take a lot of courageous foresight to build and support strong industry sales campaigns for more electrification when the needle is jumping off the scale.

Lighting Conference

While the visitor to the 2nd International Lighting Exposition and Conference in Chicago will find the great display of the newest in lighting equipment and lamps an event in itself of compelling importance, we urge him to study the conference program and to attend as many of the sessions as his time permits. Top men in lighting from all branches of the electrical industry are scheduled to bring to the conference the latest in modern lighting trends as well as practical methods of lighting application and sales. The Contractors session on Friday, November 7 will include talks by Paul Geary of NECA, Leo Gamp of St. Louis, Warren Langston of Washington and Ward Harrison of Nela Park.

Costs

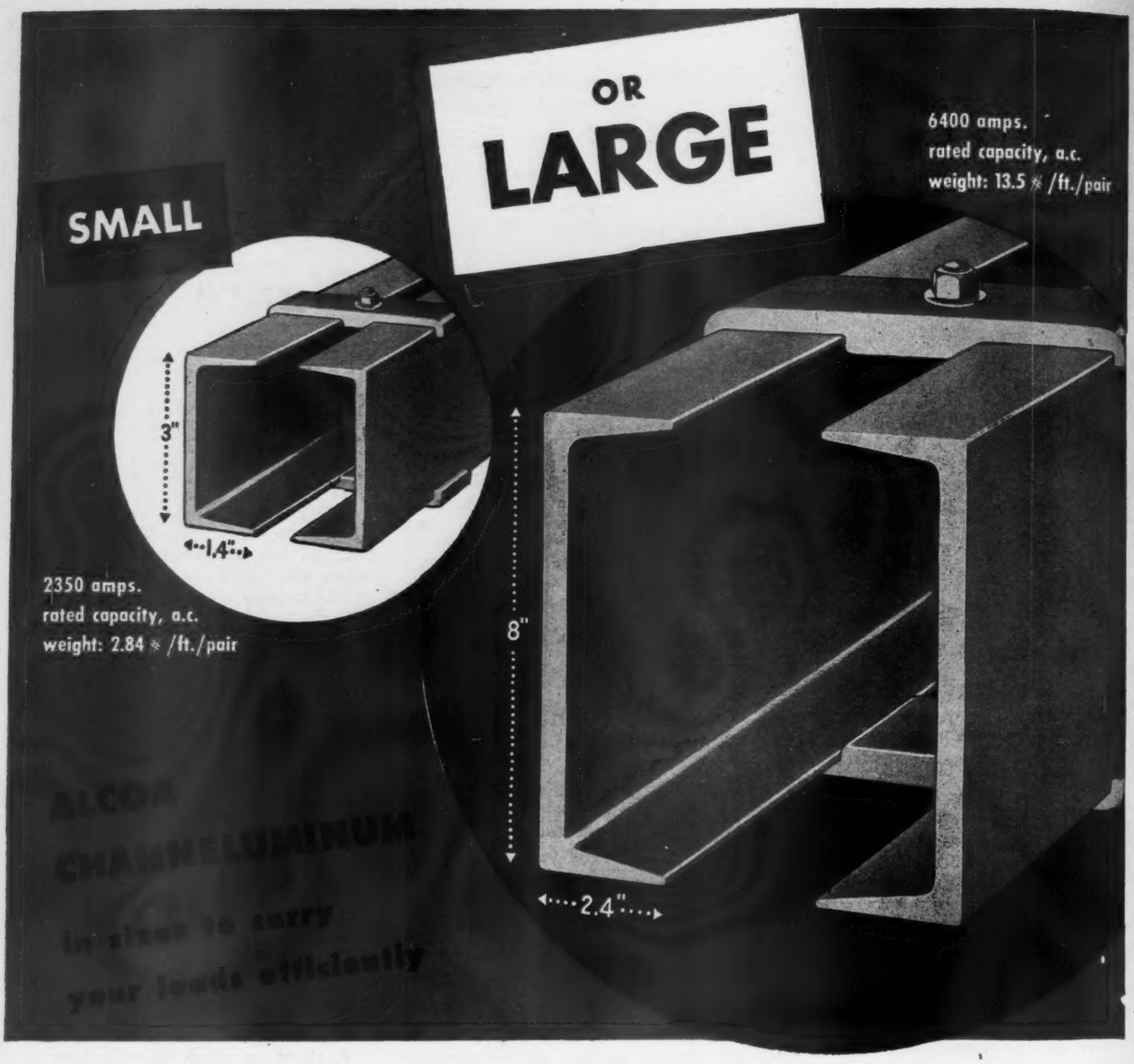
The National Eletrical Contractors Association meeting this month is devoting a large share of its program to increased productivity. The delegates will tackle a critical analysis of all elements of productivity relating to electrical construction, repair and maintenance operation with the idea of finding what steps can be taken to lower costs. The subject is timely and of vital importance. A lot of construction is tied up right now because of uncertainties as to the future course of construction costs. Electrical work is already an important factor and should become a much greater factor as new equipment comes on the market and as public demand for electric light and power grows. And the costs of electrical work are directly dependent upon productivity of workers, job tooling, flow of materials, coordination with other trades and job management. When any of these are uncertain, prudent estimating must reflect it in adequate safety margins and consequent higher prices. We hope the San Francisco convention brings forth sound plans and techniques. It will certainly add greatly to mutual understanding between labor and management of the problems involved.

Lighting Manual

We have prepared a 28 page editorial feature section devoted to planned lighting layout and design which will come to you as a part of your October issue. In it we have brought together a manual of essential data necessary for lighting system design selection, layout and installation. The subject matter is presented largely in tables, charts and diagrams, and arranged for easy use and quick reference. The tabular data have been brought completely up-to-date. Much of it is abstracted from material prepared for the new IES Lighting Handbook, an authoritative and comprehensive volume published by the Illuminating Engineering Society. A limited number of reprints of this editorial feature section will be available.

Welded Studs

A story on page 66 tells how a Pittsburgh electrical contractor performed a fast economical job of fixture installation on Q-floors. While this particular type of job is not common, it is an excellent example of smart thinking plus the efficient use of power tools. The stud welder, for example, is a relatively new tool in electrical construction. It is versatile and obviously useful for many conventional fastening jobs. It is much more so however when the job is actually planned around its use. A hole saw cuts access holes in ceiling cells very easily. It won't get tired but the mechanic will. A simple rig to apply pressure from the floor made it possible to get the full potential out of the tool. And that's the way to industry progress.



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NEW COMPETITION

IT COSTS a lot of money to start making a new electrical device. Most of the components of electrical systems are products of mass production techniques. After the original sketch comes engineering and design, then hand made models, then pilot machine set-ups, dies and fixtures, then the full production line. Somewhere along the way a sales campaign must get the product into the market. All these costs mount rapidly with no immediate compensating income.

BECAUSE A NEW IDEA is good or useful it isn't necessarily going to appear on the wholesaler's counter next week or next year. In between someone must take a serious business risk. A manufacturer struggling to make deliveries in going lines against large backlogs and material scarcities may be understandably reluctant to put effort and money into costly new ventures. Unless, that is, he is forward looking and willing to build his industry and his place in it by progressive and creative product development. Fortunately, we have many such in the electrical industry.

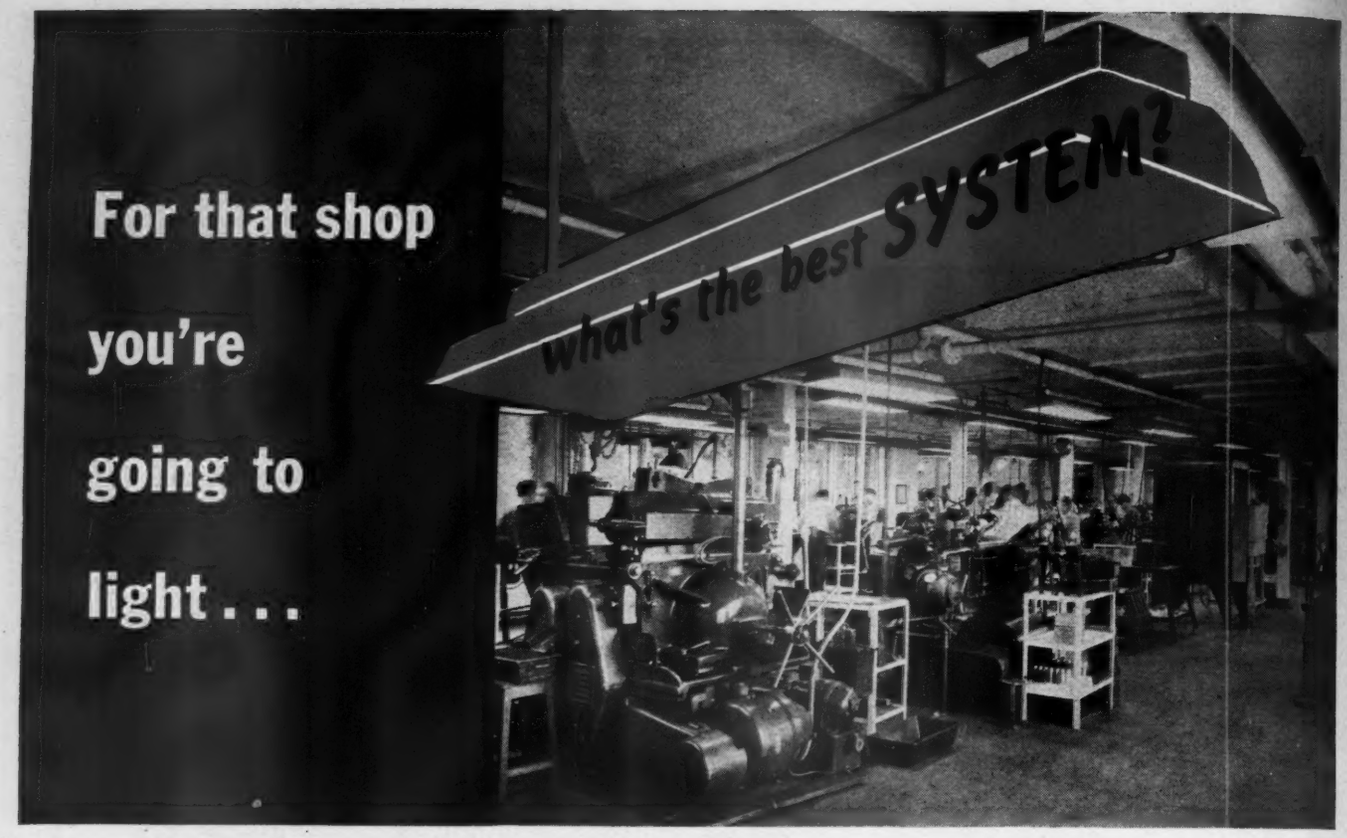
SO NEW PRODUCTS are appearing. And we can expect more as backlogs fall and deliveries ease. Are these new developments a significant forecast of the competitive situation ahead? We think they are. And we want to urge the industry to watch carefully the new products that are being announced and the new ideas that are being talked about. They are forming a pattern of vital importance to planning for the period immediately ahead.

THREE CHARACTERISTICS are almost invariably present; better adaptability to installation, superior engineering design, and salability. With the classic price competition of the 30's as a guide we might expect that new products looking toward a competitive market would be characterized by low cost. They are not. On the contrary, many are of evidently superior quality and involve more expensive materials.

SELECT AT RANDOM any recent new products or imminent developments; aluminum conduit, circline lamps, electronic heating devices, relay switching, louver ceilings, pressed steel fittings, for instance; none is particularly well suited for slugging it out at the third decimal place on the price sheet, but all offer great opportunity for meeting and solving problems of wiring system installation or utilization. All are well adapted to strong merchandising and promotion.

WITH POWERFUL economic pressure from labor and government tending to restrict the range of price variations, it is clear that competition tomorrow will be a lot different from anything we have had before. It is entirely logical that it will square off at the design and merchandising level. And the men who use electrical products will more than ever influence the trends of product development through their critical choice and selection.

Wm. F. Stuart



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Whatever the lighting requirements, Graybar can impartially recommend the exact lighting equipment for your customer's needs from the most complete selection of lamps and lighting units available from any one source.

For general or local illumination — indoors or outdoors — Graybar can provide the latest, most suitable fixtures and matching G-E lamps — plus the wire, transformers, switches, and ballasts you need.

The near-by Graybar Lighting Specialist offers you his assistance in planning any lighting installation.

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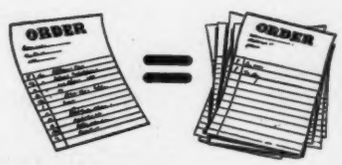

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Graybar makes it possible for you to obtain — from a single convenient source — more than 60,000 electrical items, made by over 200 leading manufacturers. Through its 96 offices and warehouses, Graybar shortens the economic distances between 200 makers and 35,000 users. One order, one responsibility, one invoice does the work of many.

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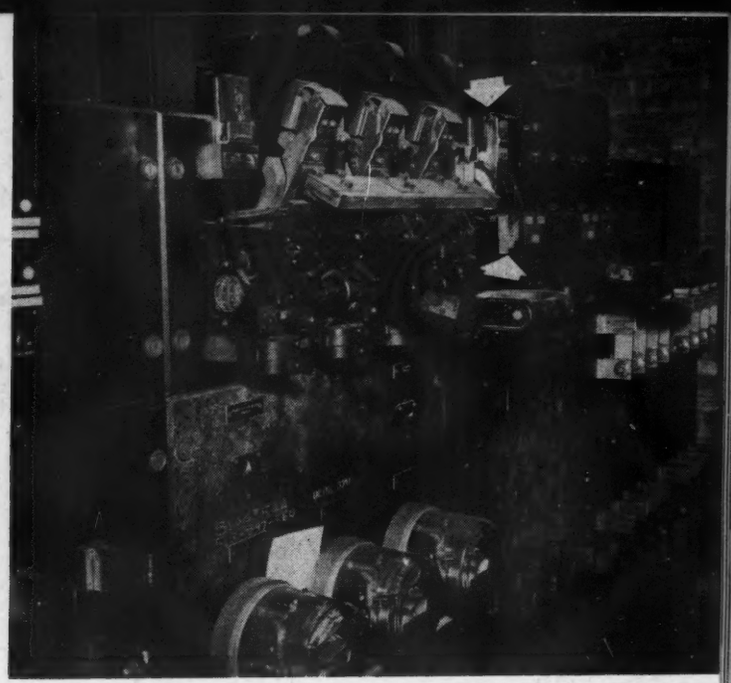
Typical revamped substation switchboard with new 5-pole switch panel in foreground. Incoming main breaker shown by arrow.



Closeup of existing 4-pole main circuit breakers on substation board. Arrows show disconnected pole of one unit added to the second to form 5-pole breaker.

Combined-Phase Distribution

How an existing 2-phase system was altered to provide combined 2- and 3-phase service at Sherwin-Williams' Chicago plant.

By W. L. CARLSON

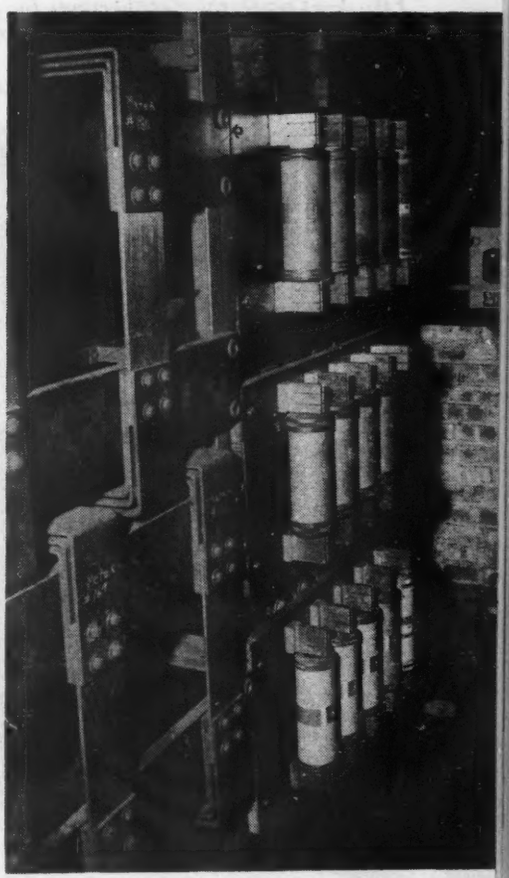
Chief Electrical Engineer, Sweningson & Company
Electrical Contractors and Engineers
Chicago, Illinois

GRADUAL transition from an existing two-phase system to three-phase service is being accomplished with a minimum of expenditures and plant interruption at Sherwin-Williams Company's Roseland Plant in Chicago.

When the decision to make this shift was made, the first question was: How can this be done without scrapping existing facilities and equipment? To arrive at an answer, Sweningson & Company was invited to analyze the problem with Sherwin-Williams' chief engineer, R. D. McIntosh, and W. A. Miller, general manager of the Chicago plants. After considerable study, we devised a scheme that would provide dual-phase service from existing power feeders with a minimum of added transformer and distribution facilities. Furthermore, all equipment involved in this plan can be used for full three-phase service when the plant is completely converted.

At present, a 12,000-volt, 3-phase, primary system feeds four transformer substations with Scott-connected transformer banks ranging from 600 kva. to 1800 kva. Two-phase, 4-wire, radial feeders consist of four 500,000 CM cables in underground fibre ducts to various buildings.

The new scheme involves the addition of a single transformer to each Scott-connected two-phase bank to form an open-delta secondary connection providing both 2-phase and 3-



Back-of-board fuse panels protect 5-conductor, two-phase three-phase radial feeders served by new 5-pole switch panel.

Combined Phase Distribution (continued)

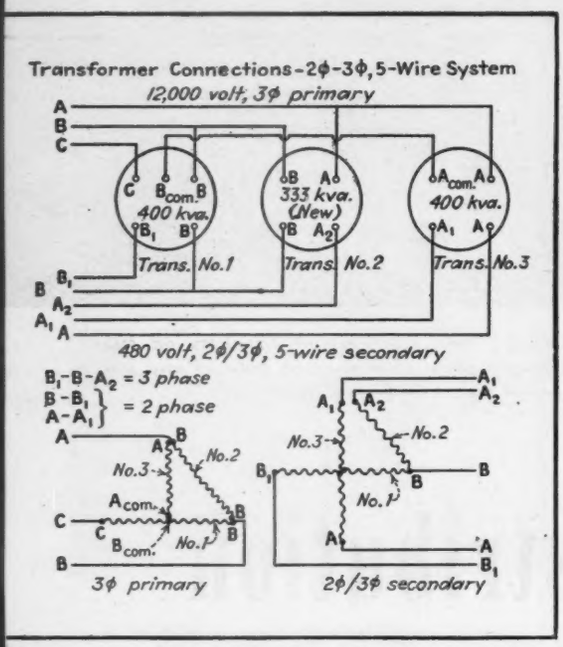


FIG. 1—Transformer connections for the combination 2-phase, 3-phase, 5-wire distribution system.

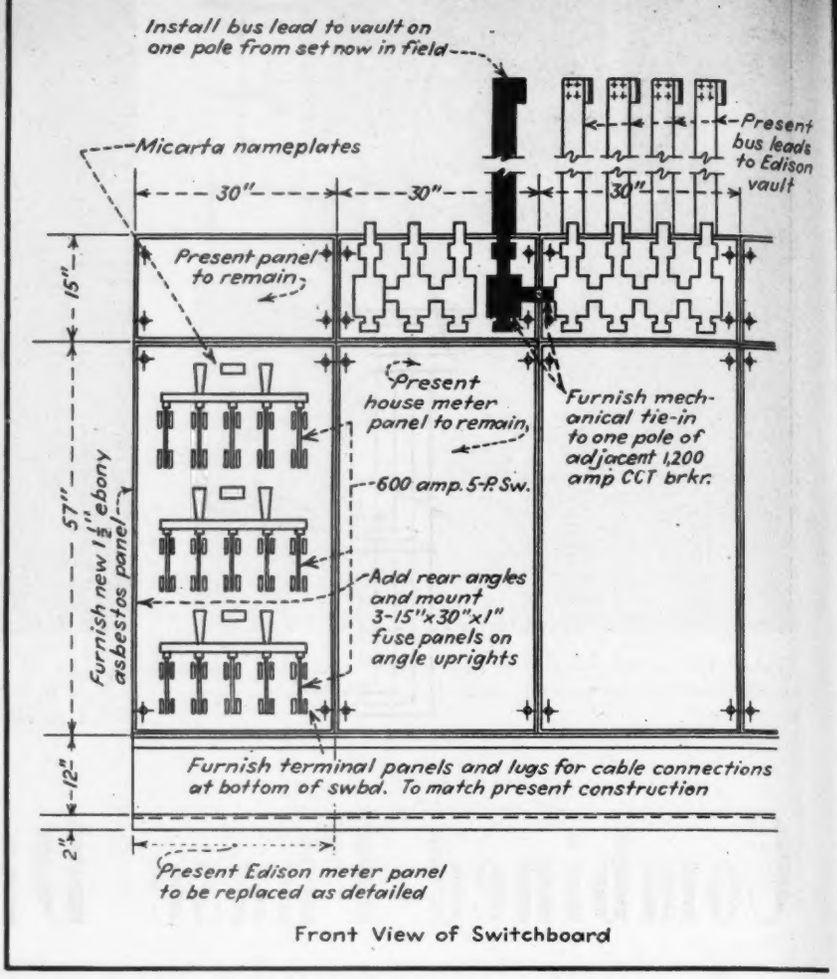
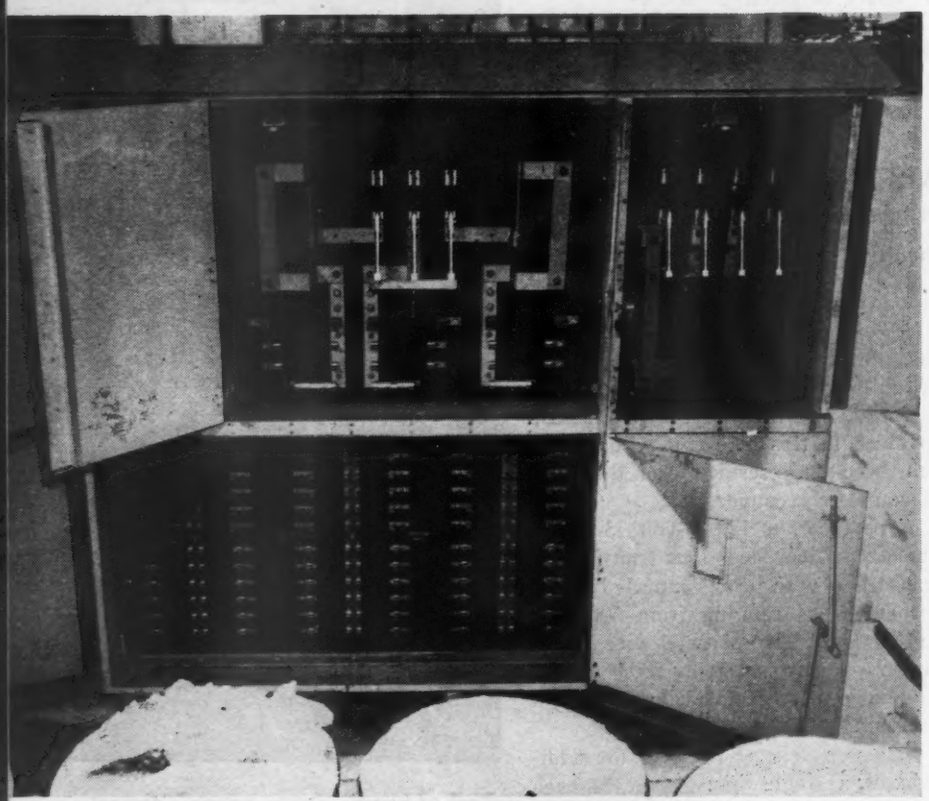

Install bus lead to vault on one pole from set now in field
Micarta nameplates
Present bus leads to Edison vault
30"
30"
30"
15"
Present panel to remain
Present house meter panel to remain
Furnish mechanical tie-in to one pole of adjacent 1,200 amp CCT brkr.
600 amp. 5-P Sw.
57"
Furnish new 1½" ebony asbestos panel
Add rear angles and mount 3-15"x30"x1" fuse panels on angle uprights
12"
Furnish terminal panels and lugs for cable connections at bottom of swbd. To match present construction
2"
Present Edison meter panel to be replaced as detailed
Front View of Switchboard

Fig. 2—Revisions made to the existing 2-phase substation



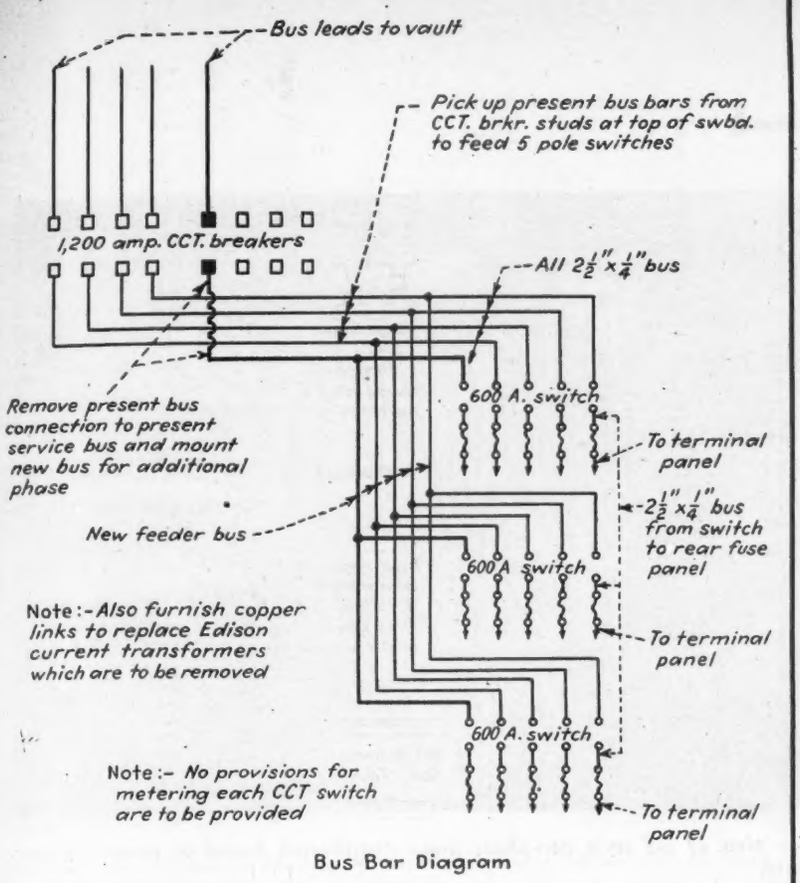
Typical new outdoor distribution panel where combined-phase feeders terminate and split up into conventional two- and three-phase branch circuits. Note current transformer locations for metering.

phase service on a 5-wire distribution system (Fig. 1). A fifth cable is added to each 4-conductor feeder. The theoretical and mathematical explanation of why and how this system functions was presented in a previous article (Multiple-Phase Distribution, pg. 51, *Electrical Contracting*, Dec., 1946). Now we shall discuss the mechanical alterations necessary to make the change.

Service and Feeder Changes

Initial step in the long range plan involved the changeover of a substation that serves 675 hp. of existing load and 350 hp. of additional 3-phase load. A substantial portion of this existing load was 3-phase equipment operating on the 2-phase system through phase-changers at the loads. These are now being eliminated as transition progresses.

The existing switchboard in this specific substation contained two 12,000-ampere, main air circuit breakers. To by-pass material shortages, we disconnected a pole of one of the breakers and, through a mechanical tie-bar, added it to the other to form


Bus leads to vault
Pick up present bus bars from CCT. brkr. studs at top of swbd. to feed 5 pole switches
1,200 amp. CCT. breakers
All 2½" x ¼" bus
Remove present bus connection to present service bus and mount new bus for additional phase
600 A. switch
To terminal panel
2½" x ¼" bus from switch to rear fuse panel
New feeder bus
600 A switch
Note:-Also furnish copper links to replace Edison current transformers which are to be removed
To terminal panel
600 A. switch
Note:- No provisions for metering each CCT switch are to be provided
To terminal panel
Bus Bar Diagram

Continued on Next Page →

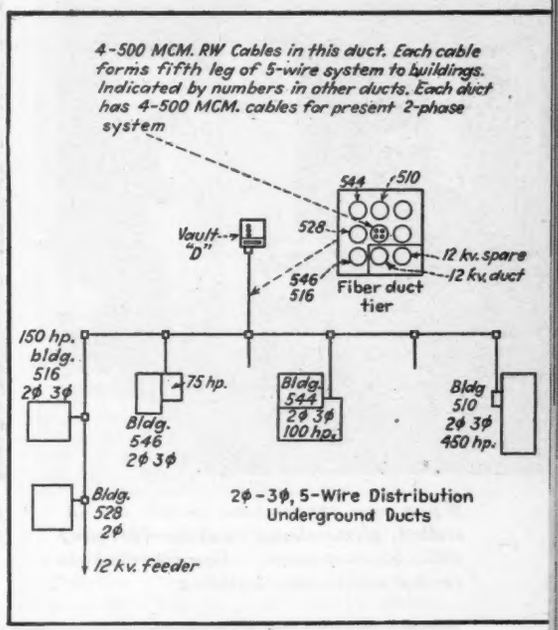

4-500 MCM. RW Cables in this duct. Each cable forms fifth leg of 5-wire system to buildings. Indicated by numbers in other ducts. Each duct has 4-500 MCM. cables for present 2-phase system
544
510
528
Vault "D"
12 kv. spare
12 kv. duct
546
516
Fiber duct tier
150 hp. bldg. 516 2φ 3φ
75 hp.
Bldg. 546 2φ 3φ
Bldg. 544 2φ 3φ 100 hp.
Bldg 510 2φ 3φ 450 hp.
Bldg. 528 2φ
2φ-3φ, 5-Wire Distribution Underground Ducts
12 kv. feeder

FIG. 3—Typical underground distribution to a group of buildings. Fifth conductor for feeders was pulled in spare duct. (see detail).

switchboard to accommodate the dual-phase, 5-wire scheme.

our 5-pole incoming secondary breaker. Switchboard buses were rearranged to provide 5-wire connection to a new panel addition containing 600-ampere, 5-pole, fused, knife-switches serving the 5-conductor radial feeders (Fig. 2). Fuses are mounted on separate panels on the back of the board. Service buses were also rearranged to accommodate the extra phase from the transformer vault.

Because the original underground distribution system was well designed with ample duct capacity, adding the fifth conductor to the radial feeders was a relatively simple matter. The extra phase conductor (A_2, Fig. 1) for each feeder was provided by four 500,000 CM, type RW, cables pulled in one of the spare ducts (Fig. 3). This was permissible since the ducts are non-metallic. The resultant 5-wire distribution terminates in outdoor panels at the various buildings where it is split up into conventional 3-phase and 2-phase, 4-wire branch circuits. Thus, both 2-phase and 3-phase equipment in each building can be operated from the combined distribution system.

Due to the hazardous nature of production processes, all heavy elec-

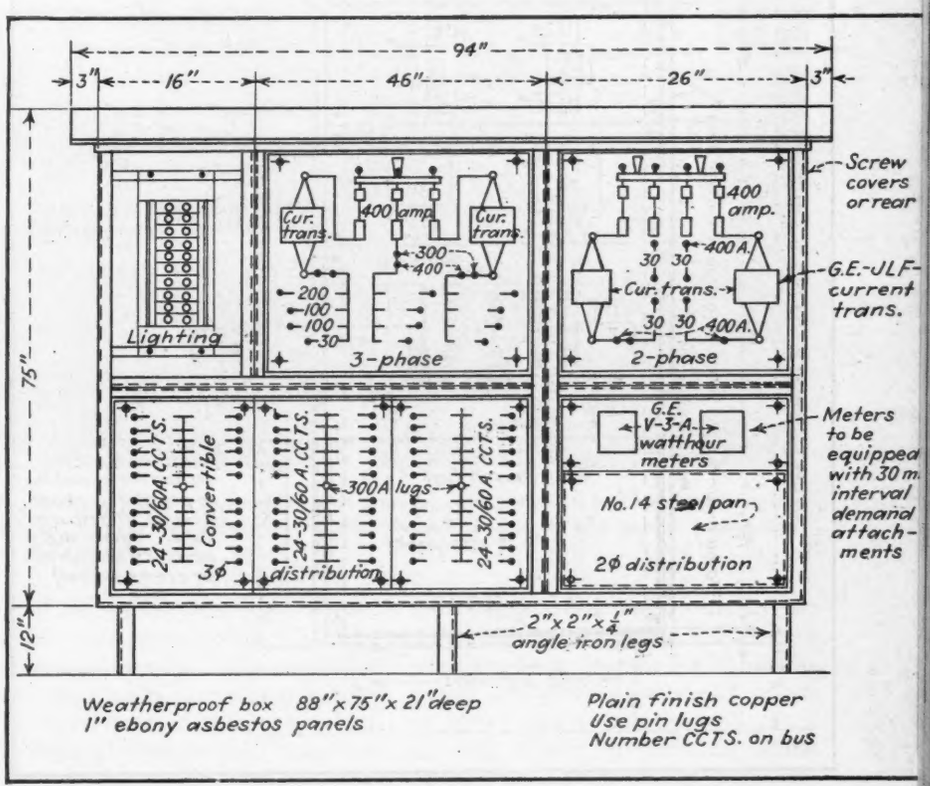
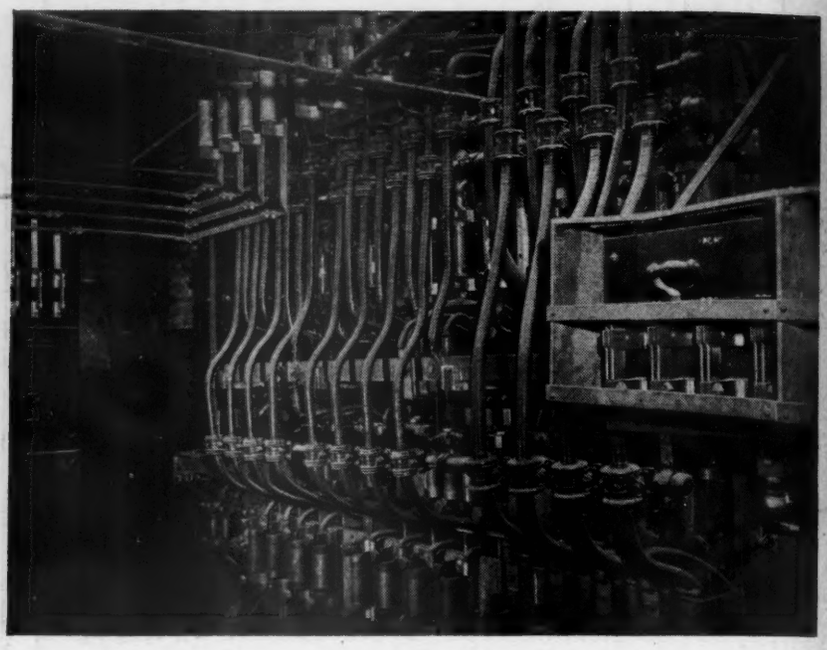


FIG. 4—Details of a combination distribution panel where the dual-service feeders were split up to serve conventional 2-phase and 3-phase branch circuits.

Combined Phase Distribution (continued)

When new three-phase panels are installed, phase-changers above (arrows) will be removed. Combined-phase feeder serves this building.



Rear view of old style two-phase main distribution board in present power house.

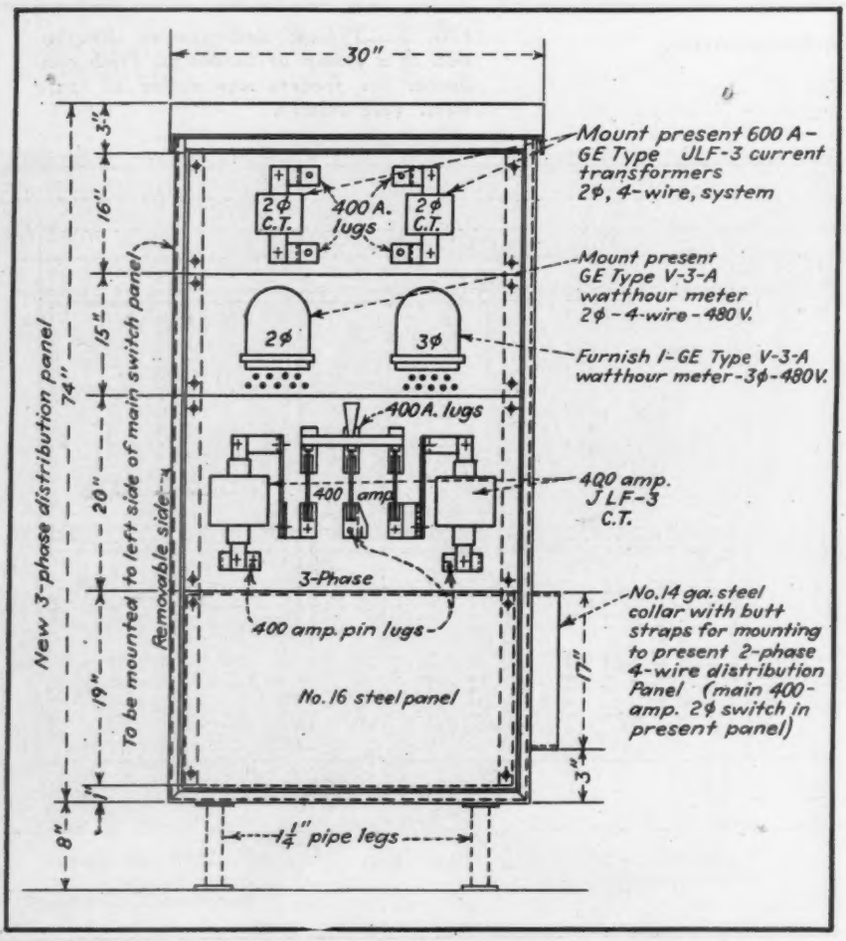


FIG. 5—Details of entrance and metering panel installed where existing 2-phase distribution panel is retained. Three-phase branch circuit panel to be added at left. Existing 2-phase panel to be connected at right.

trical control equipment (standard construction) is enclosed in weatherproof cabinets on the building exteriors. In some cases, completely new dual-service panels containing 3-phase and 2-phase branch circuits were designed (Fig. 4). Where existing 2-phase distribution panels were utilized, new 3-phase entrance panels with adjacent distribution facilities were added (Fig. 5). In all cases the two

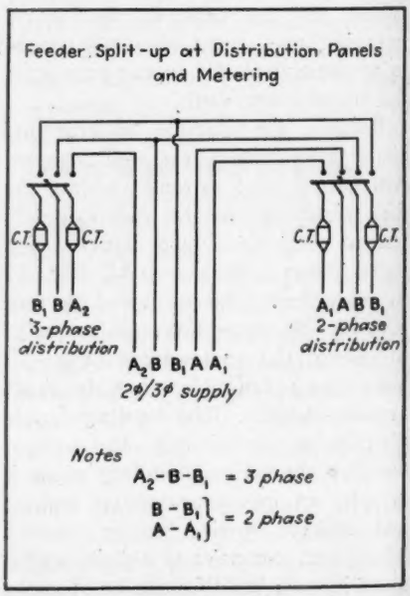
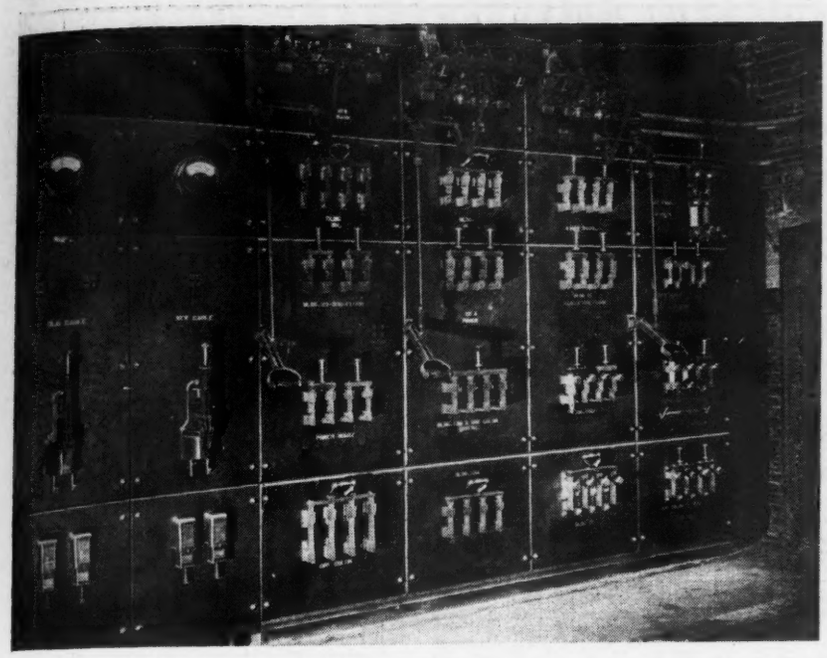


FIG. 6—Diagram of 5-wire feeder split-up and dual-phase metering at the distribution panels.



Following completion of changeover and new power house with three-phase generating facilities, this old two-phase board in present power house will be dismantled.

Typical three-phase entrance cabinet installed where present two-phase distribution facilities are used. Three-phase distribution panel will be added.

loads are metered in these panels where the dual-service is split up to feed the various circuits (Fig. 6).

System Advantages

Among the outstanding features of this 5-wire, combined-phase distribution are:

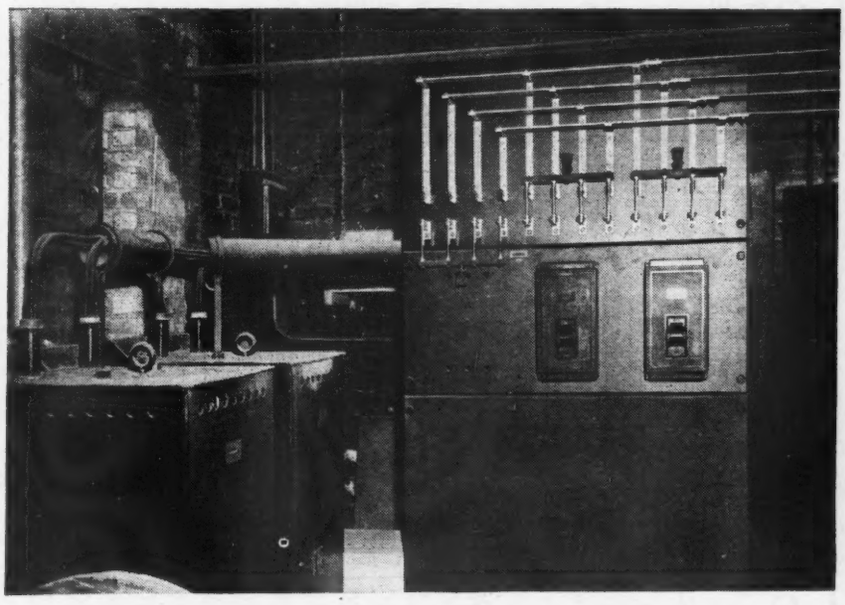
Adaptable to Gradual Change — The system feeds both 2-phase and 3-phase loads. As old equipment is replaced by new 3-phase units, these branch circuits are altered and shifted to the 3-phase panels. When transition reaches a point where only a few 2-phase units remain in a building, that structure can be connected full three-phase and previously eliminated phase-changers connected in reverse to serve the last few 2-phase motors.

Low Transition Cost—From the standpoint of additional transformer capacity and distribution facilities, this method is the most economical way to make the changeover. Installation and operating costs are held to a minimum since duplicate equipment, feeders and phase-changers are eliminated.

Use All Equipment—All existing substation transformers, switchboards, radial feeders and building distribution panels were utilized to provide the combination service. All will be used for full three-phase distribution when complete changeover occurs. The present Scott-connected and open-delta transformer banks can be re-connected to a closed-delta, 3-phase secondary.

Additional Capacity—After full conversion is reached, the three-phase capacity of each substation will be 75 percent greater than that of the old two-phase banks. Also, at that time, three-phase radial feeder capacity can be doubled by adding one cable of the same size to the present 5-wire system.

Wider Equipment Choice—Transition to three-phase distribution will afford a wider choice of electrical equipment, particularly in the explosion-proof category and open the way to broader application of electronic control to many production processes.



When three-phase conversion is complete, these two 75-kva. phase-changers behind present two-phase main distribution board in old power house will be eliminated.

TABLE I – CONSTRUCTION PERIODS FOR ECONOMIC OPERATION OF ELECTRICAL INSTALLATION PROJECTS – INDUSTRIAL.

SEE NOTES BELOW

CONTRACT DATA						LABOR		CONSTRN. PERIODS-SEE SKETCH BEL.									TOTAL PERIOD		AV. NO OF MEN EMPL.
SELL PRICE	BASE COSTS			JOB COSTS & MARKUP		MAN HOURS	MAN DAYS	1 & 6			2 & 5			4 & 3					
	MATERIAL	LABOR	L. & M.	%L&M	DOLLARS			DAYS	MEN AV.	MAN DAYS	DAYS	MEN AV.	MAN DAYS	DAYS	MEN AV.	MAN DAYS	DAYS	WKS.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
10,000.	3,750.	2,500.	6,250.	60.0	3,750.	1,250	156	10	2	20	12	4	48	15	6	90	37	7.4	4.2
25,000.	9,450.	6,300.	15,750.	58.7	9,250.	3,150	394	12	2	24	35	6	210	16	10	160	63	12.5	6.3
50,000.	19,200.	12,800.	32,000.	56.2	18,000.	6,400	800	12	2	24	52	8	416	30	12	360	94	19.	8.5
100,000.	40,800.	27,200.	68,000.	47.7	32,000.	13,600	1700	15	4	60	75	12	900	37	20	740	127	25.4	13.4
200,000.	84,000.	56,000.	140,000.	42.9	60,000.	28,000	3,500	20	4	80	125	16	2,000	60	24	1,440	205	41	17.1
300,000.	132,000.	88,000.	220,000.	36.5	80,000.	44,000	5,500	30	5	150	145	22	3,190	60	36	2160	235	47	23.4
400,000.	178,500.	119,000.	297,500.	34.5	102,500.	59,500	7,440	30	5	150	160	26	4,160	70	45	3,150	265	53	28.5
500,000.	225,000.	150,000.	375,000.	33.3	125,000.	75,000	9,375	35	5	175	175	30	5,250	75	53	3,975	285	57	33.
600,000.	270,000.	180,000.	450,000.	33.3	150,000.	90,000	11,250	40	5	200	185	34	6,290	80	60	4,800	305	61	37.
750,000.	337,000.	225,000.	562,000.	33.3	187,500.	112,500	14,060	42	7	294	225.	37	8,325	85	64	5,440	350	70	40.
1,000,000.	450,000.	300,000.	750,000.	33.3	250,000.	150,000	18,750	45	11	495	270	45	12,150	85	72	6,120	400	80	47.
1,250,000.	570,000.	380,000.	950,000.	31.7	300,000.	190,000	23,750	50	14	700	295	54	15,930	90	80	7,200	435	87	54.5
1,500,000.	680,000.	460,000.	1,140,000.	31.6	360,000.	230,000	28,750	60	15	900	300	66	19,800	90	90	8,100	450	90	64.
1,750,000.	801,000.	534,000	1,335,000.	31.0	415,000.	267,000	33,375	65	16	1,040	304	72	21,888	95	110	10,450	465	93	72.
2,000,000.	915,000.	610,000	1,525,000.	31.0	475,000.	305,000	38,125	70	18	1,260	310	79	24,490	100	125	12,500	480	96	80.

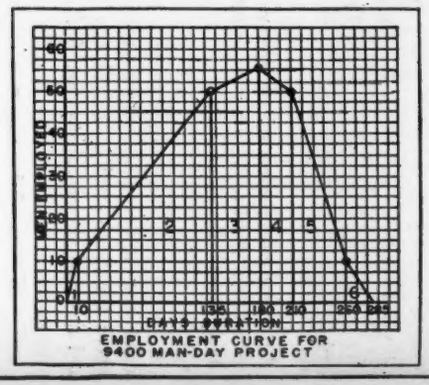
NOTES-CALC.& BASE FIGS:-

1- AS FIGS. ARE ONLY APPROX., MINOR IRREGULARITIES HAVE NOT BEEN IRONED OUT.

2- BASE FIGURES- A-"60/40" PROJECTS (MAT. 60%-LAB. 40%). B-LAB. RATE $2.00/HR. C.-5 DAY WEEK. D-INS. & EMPL. BENEFITS-14.5%. E-ENG., SUPERVISION, TOOLS, INSURANCES, ETC. INCLUDED IN JOB COSTS.

3- PERIODS FOR CONSTRUCTION TIME BASED ON PROGRESS FREE OF INTERFERENCE FROM OTHER TRADES AND OPERATIONS.

4- CONTRACTORS, MANNED, EQUIPPED, AND ORGANIZED TO EXPEDITIOUSLY CARRY ON THE WORK.



ESTIMATED OPTIMUM DURATION FOR A JOB REQUIRING 9400 MAN-DAYS (SEE $500,000 PROJECT)

PERIOD	DAYS	NO. OF MEN-AV.	MAN DAYS
1	10	5.	50
2	125	30	3750.
3	45	53.	2385.
4	30	53	1590.
5	50	30	1500
6	25	5	125.
TOTALS	285		9400

ELECTRICAL CONTRACTORS' ASS'N. OF CITY OF CHICAGO

Volume-Duration Studies... Part I

By Ray Ashley

Research Engineer
Electrical Contractors Association of City of Chicago

A discussion of a new guide for estimating approximate manpower requirements and optimum duration periods for industrial electrical construction projects. A new approach to an old problem.

HOW long will the job run? What will be the normal and maximum number of men required? Will the demand for men be fluctuating or steady? Is the project a desirable undertaking?

Answers to these questions fall in the "must" category for electrical contractors who want to capitalize on the opportunities now offered. With work plentiful, materials hard to get, supply of suitable mechanics limited, and organizations taxed to capacity, contractors must analyze every detail of contemplated work in order to select jobs on which their efforts will be most effective.

We find that contractors seldom fail to consider these questions when figuring work and, for the most part, do a creditable job estimating direct job labor. It takes more, however, than accurately estimating direct labor to make a successful business. The cost of supplying that labor must also be figured accurately, and prudence exercised in selecting the jobs on which it is to be expended.

Direct job labor estimates usually are accurate because labor data records of previous jobs serve as a gage. Such records, however, are seldom sufficient to provide data for accurately figuring *direct job costs and overhead.*

Recognizing the need for a suitable guide for analyzing manpower and other requirements of electrical construction projects, the Electrical Contractors' Association of City of Chicago prepared tables based on actual job experiences. Some of these accompany this article.

Periods For Economic Operation

Table I is designed to serve as a guide for estimating manpower requirements and approximate construction duration periods. Before explaining how it functions, it will be well to discuss its development.

The best one can hope to do with a single table is to provide data which are applicable only where specific conditions exist. Such figures serve as a criterion for estimating demands of other work where conditions vary.

Table I was prepared for industrial projects which comply with the following stipulations:

1. Contractors fully and adequately equipped, manned, and organized to expeditiously prosecute the work.
2. Electrical contractor in full control of material purchases and deliveries.
3. Material-Labor ratio 60/40 (base cost 60 percent material and 40 percent labor).
4. Projects, such as industrial, which can proceed as individual unit without being confined to the progress of other trades.
5. Operations carried on during normal construction periods.
6. Five-day, forty-hour week.

The foregoing assure conditions approaching the ideal. Compensation for any deviations from these stipulations must be made when figuring labor and operating costs.

The table shows estimated manpower requirements and optimum duration periods for contracts of various volumes. The estimated sell price (see Col. I) was included because: (1) We ordinarily think of duration periods in terms of the sell price; and (2) we deal in terms of the contract price when negotiating with customers.

Estimated selling prices are based on prevailing (11-20-46) Chicago rates for labor, insurances, and inspection. Markups are in line with what the studies show to be equitable charges for services, and conservative allowances for return.

The accompanying estimates (see Figs. 1 and 2) show the relative distribution of costs. Since no specific projects are represented, figures (Table I) have to be more or less approximate. No effort has been made to smooth out all tables, and the markup and job cost columns show the dollars in round figures.

To better understand the base table, trace a horizontal row of figures across the sheet. Take, for example, a $500,000 project which has for direct job costs $225,000 allotted to material and $150,000 to labor. Material is 60 percent and labor 40 percent of the sum of the two.

The sum of the estimated direct job and operating costs, and the allowance for return, is shown in Col. 6. A study of the accompanying estimates will reveal how these costs were developed. Column 5 shows what percentage Col. 6 is of the base cost (Mat.-Lab.). These percentages show that allowance has been made for the decrease in operating costs as projects increase in volume.

The man-hours shown in Col. 7 were obtained by dividing the labor cost by two. The journeyman rate is $1.97½ per hour. For all practical purposes, it can be assumed that the average rate of foremen and journeymen is $2.00 per hour.

Data shown in Cols. 9 to 17 inclusive are for establishing duration periods and manpower requirements. The employment curve at the bottom of the table depicts the position of the various construction periods represented in these columns.

The tables and curve show six periods of construction. Period 1 is the initiation, or preparation phase, and should be of short duration. Period 2 is the build up section. It should be long enough to permit selecting and organizing suitable mechanics but not prolonged to a point where operating costs are excessive.

Periods 3 and 4 represent the peak periods. The flatter this portion of the curve is, the more desirable the job will be.

Period 5 is the main dissolution

PRICING SHEET DATE SEPT. 6 1946

JOB OR BLDG. VOLUME-DURATION STUDIES SUPPLEMENTARY SHEET NO. 2

BID TO APPROX. DIV. OF COSTS FOR A ADDRESS

ARCHT OR ENG'R $500,000 (SELL) PROJECT ADDRESS

PLANS MARKED SCALE SPEC. No. EST. No.

EST. BY PRICED BY EXTENSIONS BY CHECKED BY S.O No. SHEET No

MATERIAL	QUANTITY	MATERIAL UNIT	EXTENSION	LABOR UNIT	EXTENSION
			MATERIAL		LABOR
ESTIMATED BASE COSTS			225000 –		150000 –
MAT. SERVICE & LAB. BURDEN – SEE NOTE		3%	6750 –	12%	18000 –
INSURANCES & EMPL. BENEFITS		–	–	14.5%	21750 –
RESERVE FOR CONTING. & GUARANTEE		2%	4500 –	5%	7500 –
JOB COSTS			236250 –		197250 –
OVERHEAD & ADMIN. EXP.		3%	7085 –	14%	27615 –
			243335 –		224865 –
RETURN		4%	9735 –	10%	22485 –
			253070 –		247350 –
ESTIMATED SELL PR.					
MATERIAL	253070				
LABOR	247350				
TOTAL	500420				
USED – 500,000.					

NOTE:-
MATERIAL SERVICE & LABOR BURDEN INCLUDE COSTS OF SUPERVISION, ENG., TOOLS, INSPECTION (PERMITS), ASSN. DUES, AND ALL OTHER DIR. JOB COSTS EXCEPT INS.

FIG. 1

Typical cost distribution for a $500,000 electrical project.

period. It must be short enough to avoid having the job drag, and at the same time long enough to permit other projects to absorb the mechanics relieved.

Period 6 is the "clean-up" period and is often a difficult one to conclude. Generally speaking, the shorter it is, the less the labor costs. A detailed discussion of the application of these data follows.

Construction duration data are presented in three specific groups (Cols. 9 to 17 incl.) corresponding to construction periods previously discussed. Each group comprises three columns, the first of which shows estimated working days. For a $500,000 project, we find 35 days for periods 1 and 6 (Col. 9); 175 days for periods 2 and 5 (Col. 12); 75 days for periods 3 and 4 (Col. 15); and a total of 285 days for the complete project (Col. 18). On the basis of a 5-day week, 285 days represents 57 weeks (Col. 19) or a little over 13 months. The total man-days for the complete project is approximately 9,400 (Col. 8 shows 9,370). Man-days required for the various construction periods are shown in Cols. 11, 14 and 17. To obtain the average number of men required to handle the $500,000 project, divide the 9,400 man-days by 285 days. The result (Col. 20) is 33 men.

No allowance is made in either the tables or curve for return trips to correct errors or replace faulty materials. Such costs are supposed to be covered by the "Reserve for Guarantee and Contingencies" item in the estimate.

While studying these tables and curves, one must constantly bear in mind the limitations previously set forth. *Only when conditions approaching the ideal exist, can optimum duration periods be realized.*

Optimum Duration

There is an optimum duration for a project of a given size. This period may be considered from the standpoint of: (1) The cost of the project, as shown in Table I; or (2) the individual contractor's ability.

Optimum duration from the standpoint of the contractors who are not equipped and organized to carry on the work is longer than that indicated by the table. All other things being equal, however, the total cost of the job would be greater if performed by the contractor requiring the longer time. Estimated optimum periods, in all cases, are subject to some tolerance. A variation of 10 to 15 percent up or down, would not ordinarily be considered out of line.

Many labor units in use today were established in 1938 when working conditions approached ideal. It is consistent, therefore, to have tables of manpower requirements also based on especially favorable working conditions.

Estimating Irregularities

Normally, costs vary according to job requirements and general building conditions. Contractors seldom enjoy conditions as near ideal as they were in the late thirties.

Since the beginning of the war, construction programs have been erratic and numerous influences prevented economic use of manpower. The accompanying labor curve for a wartime project shows very plainly why labor costs on such work were excessive. The curve shows that in 18 weeks (16th to 34th week) 340 men were added, an average of almost 20 men per week. Electrical contractors are too familiar with the excessive costs of meeting such manpower demands to warrant a lengthy discussion on the subject.

It is the estimator's work to anticipate the job requirements and figure labor and operating costs accordingly. The following are some of the more common factors to be considered.

1. Labor market.
2. Losses resulting from manning jobs too rapidly

3. Costs of meeting fluctuating and peak demands
4. Contractors' ability to meet the job demands

The labor market usually presents two problems: Productivity and availability of mechanics. To meet the sudden demands for mechanics, contractors have practically doubled their crews in the last few years. Due to lack of training, inability to learn quickly, old age, and many other reasons, the average productivity of these new men is low. Until apprentices begin to complete their training, about 70 percent is all we can expect to get from crews recruited so rapidly. With half the mechanics producing 100 percent and half only 70 percent, the average productivity is approximately 85 percent (based on 1938 standards). This does not consider other factors which interfere with work schedules and still further reduce the job productivity.

Mechanics are more readily available for some jobs than others. With work plentiful, men are very independent about the location and the kind of work they select. Jobs off the beaten path have difficulty getting men, and the turnover is high. If the work is not considered desirable and the location hard to reach, a contractor may have four 100 percent mechanics (recruited from his regular crews) and six 60 percent mechanics. The resultant productivity is 76 percent. The turnover of the group of six may reduce their productivity to 50 percent, and the gang rating would then become 70 percent. These difficulties exist today regardless of the type of project, but the more irregular the job requirements, the more serious they become.

Losses incurred by manning jobs too rapidly and meeting fluctuating demands, can only be approximated by experienced estimators. Space does not permit a lengthy explanation of estimating such costs. In figuring them, one not only has to consider the losses on the job contemplated, but must also make allowances for losses on other work which temporarily relieves men to take care of fluctuating demands.

The ratio of the job being figured to the normal volume of business is usually a good gage of a contractor's capacity to handle work, and should always be considered. Contractors who take work out of proportion to their normal capacity, may be inviting trouble.

PRICING SHEET DATE SEPT. 6 1948

JOB OR BLDG. VOLUME-DURATION STUDIES — SUPPLEMENTARY SHEET NO. 1
BID TO APPROX. DIV. OF COSTS FOR A — ADDRESS
ARCHT. OR ENG'R. $10,000. (SELL PR.) PROJECT — ADDRESS
PLANS MARKED — SCALE — SPEC. No. — EST. No.
EST. BY — PRICED BY — EXTENSIONS BY — CHECKED BY — S.O.No. — SHEET No

MATERIAL	QUANTITY	MATERIAL UNIT	MATERIAL EXTENSION	LABOR UNIT	LABOR EXTENSION
			MATERIAL		LABOR
ESTIMATED BASE COSTS			3750 -		2500 -
MAT. SERVICE & LAB. BURDEN - SEE NOTE		5%	187 -	22%	550 -
INSURANCE'S & EMPL. BENEFITS		—	—	145%	362 -
RESERVE FOR CONTING. & GUARANTEE		3%	112 -	6%	150 -
JOB COSTS			4049 -		3562 -
OVERHEAD & ADMIN. EXP.		10%	405 -	31.5%	1122 -
			4454 -		4684 -
RETURN		8%	356 -	10%	468 -
			4810 -		5152 -
ESTIMATED SELL PR.					
MATERIAL	4810.				
LABOR	5152				
TOTAL	9962				
USED — 10,000.					

NOTE:- MATERIAL SERVICE & LABOR BURDEN INCLUDE COSTS OF SUPERVISION, ENG, TOOLS, INSPECTION (PERMITS) ASSN DUES, AND ALL OTHER DIRECT JOB COSTS EXCEPT INSURANCES

ELECTRICAL CONTRACTORS ASSN OF CITY OF CHICAGO

FIG.2

Cost analysis for a typical $10,000 industrial electrical job.

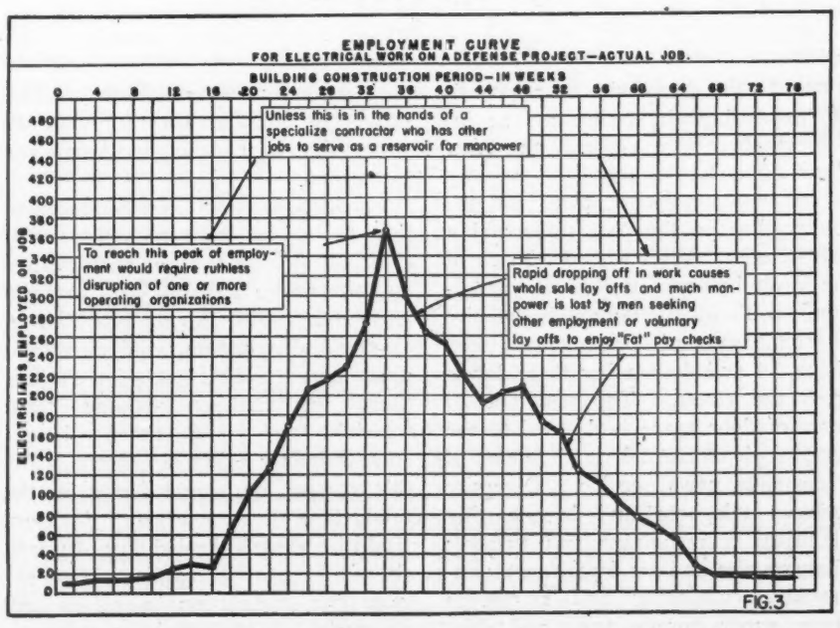
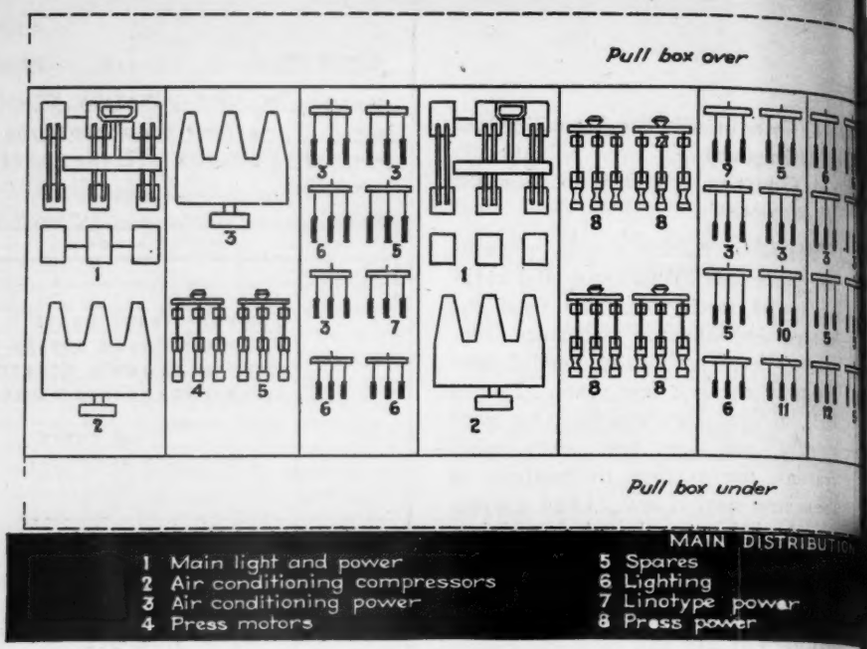

EMPLOYMENT CURVE
FOR ELECTRICAL WORK ON A DEFENSE PROJECT—ACTUAL JOB.
BUILDING CONSTRUCTION PERIOD—IN WEEKS
ELECTRICIANS EMPLOYED ON JOB
Unless this is in the hands of a specialize contractor who has other jobs to serve as a reservoir for manpower
To reach this peak of employment would require ruthless disruption of one or more operating organizations
Rapid dropping off in work causes whole sale lay offs and much manpower is lost by men seeking other employment or voluntary lay offs to enjoy "Fat" pay checks

FIG.3

Employment curve for a defense project. Peak demand is disruptive.



Partial view of main distribution switchboard shows fuses located on front to facilitate rapid emergency replacements. Transite boxes are erected over switches to protect operators. Current is carried to four main pressure switches through forty-six 4 by ¼-inch copper busbars.

WIRING of

Expansion and modernization of a large metropolitan newspaper plant places emphasis on reliable electrical engineering, sound installation know-how and dependable maintenance.

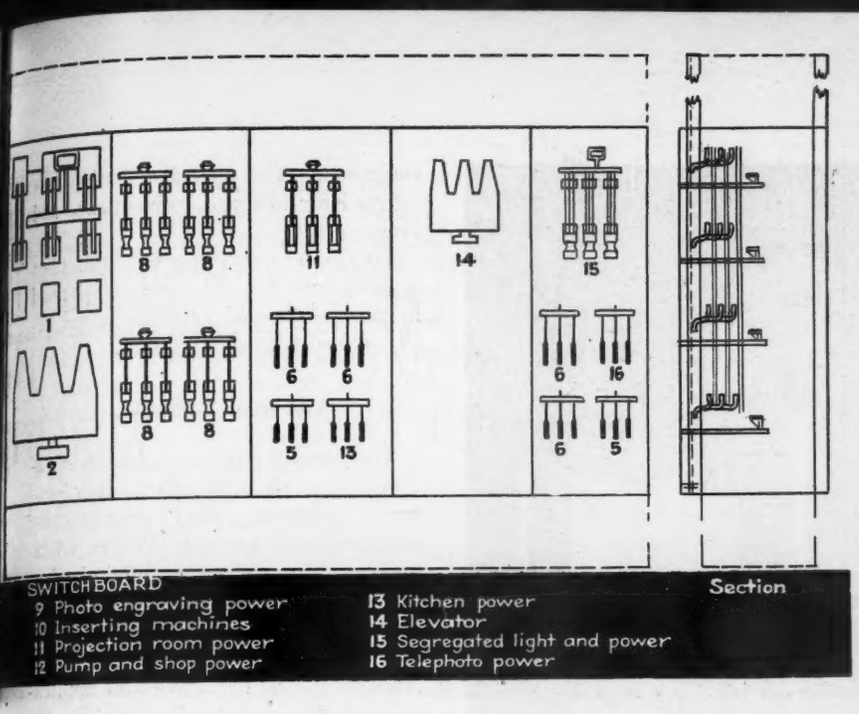
By Hugh P. Scott

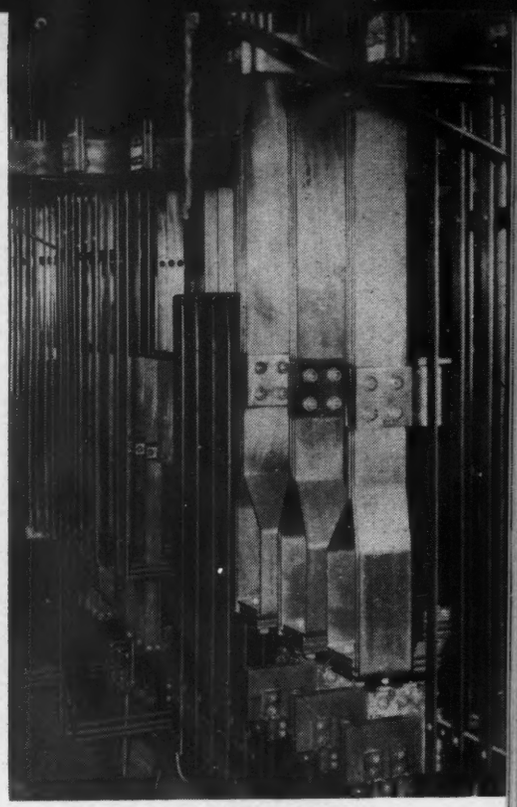
KEEPING pace with a constantly expanding circulation and an increasing page content, the *New York Times* has enlarged the capacity of its vast newspaper plant for the fourth time in the past three and a half decades. With the completion of the latest half-acre twelve-story addition, the Times Building now occupies a ground area of 60,000 square feet, rising 14 and descending three levels from the street. The resultant 20 acres of floor space is devoted to the complex departmental requirements of a complete news service. Diversity includes telephoto and broadcasting facilities; a restaurant and theatre; photographic and art departments; engraving, composing and stereotype areas; paper storage, press and shipping sections; research library, filing provisions and office space for editorial, advertising, news and circulation departments.

Throughout *The Times* organization, the accent is on reliability: reliability of information, of performance and of service. Reliability of performance and service directs attention to electrical distribution, equipment and maintenance. With successive editions timed for final-act curtains, train schedules and plane takeoffs, breakdowns directly affect circulation. For this reason, no single factor in the production of a newspaper is more vital than electrical reliability. Insured electrical continuity requires sound engineering, installation know-how and preventive maintenance. In modernizing their existing system and installing required capacity for their latest addition, *The Times* placed responsibility for these three requisites in the hands of Consulting Engineers Meyer, Strong and Jones; Electrical Contractor Van Wagoner Linn, and Plant Supervising Electrical Engineer John B. Folk. Architectural plans, prepared in the office of Shreve Lamp and Harmon, were structurally executed by the Rheinstein Construction Company.

In conjunction with the new construction program, existing departments and areas were expanded, rearranged and relocated to speed the flow of production and increase plant efficiency. Elevator shafts were shifted and additional high-speed passenger and freight cars were added. Lighting was revamped. Existing d-c requirements were altered in favor of modern a-c equipment. Extra presses were installed.

The new motor-generator and switchboard room is on the first subgrade level, adjacent to the utility company's transformer vault. Distribution is three phase a-c, 4-wire 120/208-volts for light and 3-wire 208-volts for power. The switchboard, product of the Metropolitan Electric Manufacturing Company, is approximately 36 feet in length, 8 feet high and constructed



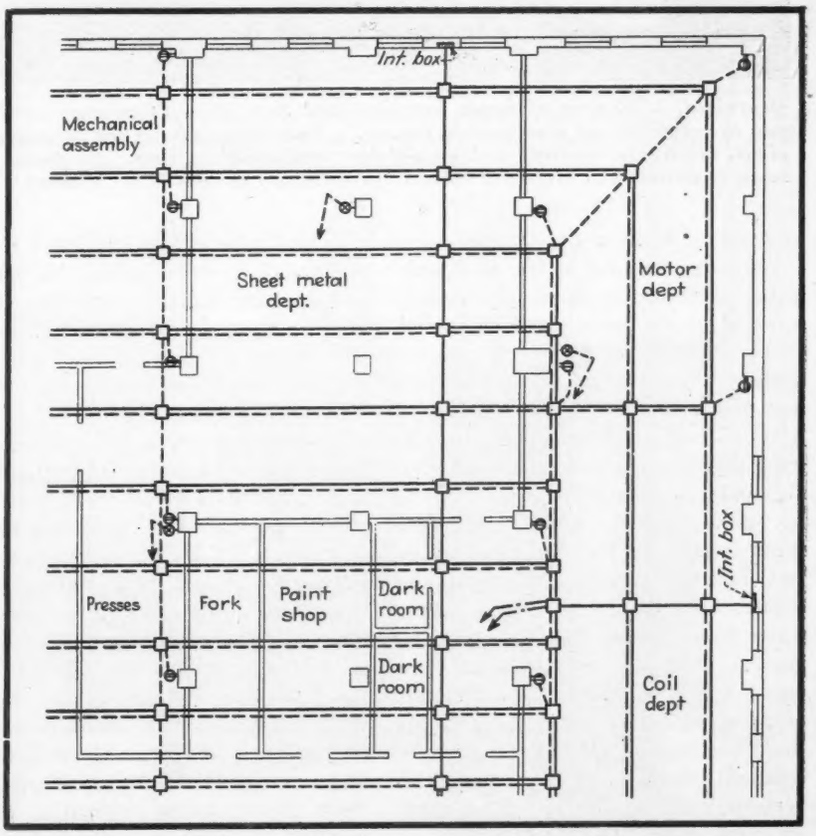


To provide for ample heat dissipation, no bus lamination or knife switch carries more than 1000 amperes. Easy access to all connections on rear of main a-c board is possible due to liberal spacing of busses. Busbars from utility vault are above head height. Power distribution is 208 volts.

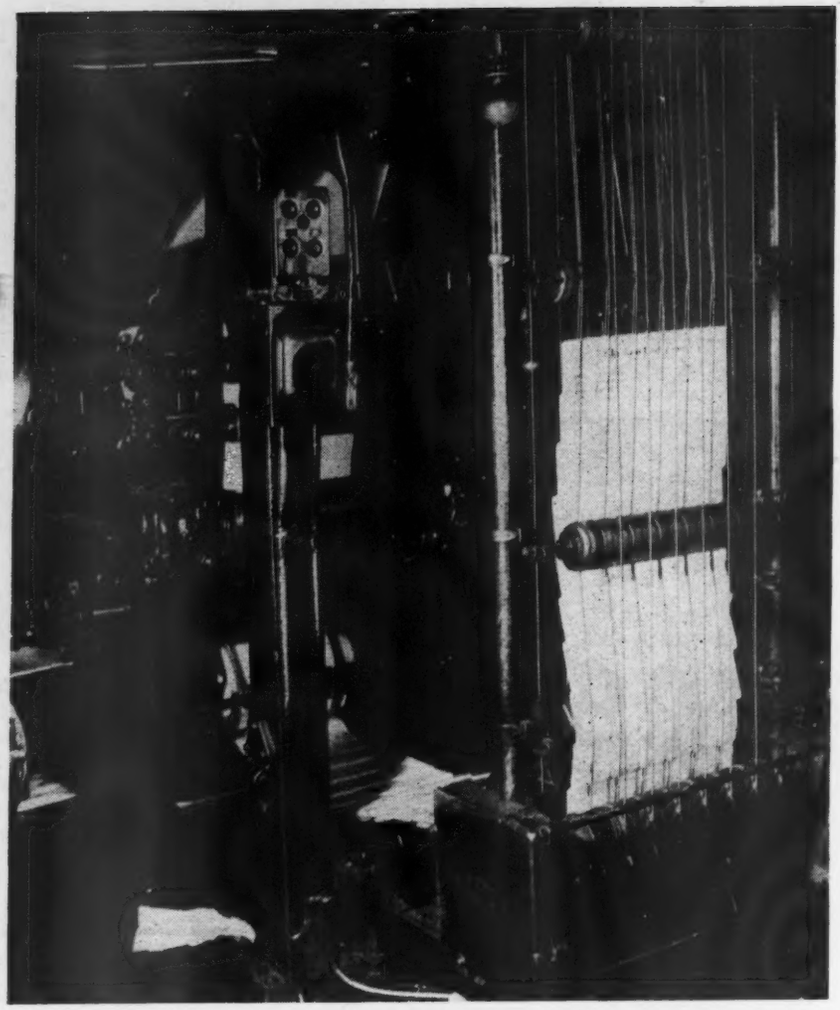
the Times

of 2-inch ebony asbestos. Fuses are installed on the front of the board; busbars and connections on the back, supported independently of switch studs and with main busses supported in soapstone seats. All current carrying parts are designed for ample heat dissipation, no single knife switch or bus lamination carrying more than 1000 amperes. The board is free-standing with main busbars mounted above head level. Sufficient space is provided between bars to permit easy access to all connections. The board is designed for rapid visual inspection, fuse replacement, maintenance and adjustment.

Bus connections between service entrance and switchboards are protected by wire mesh enclosures. Services from the new transformer vault are four in number, carrying current to the four sections of the board. Three main services, each consisting of fourteen 4 by ¼-inch busses (4 per phase and 2 for neutral), are connected to the board through pressure type switches rated at 4000 amps. The fourth service for segregated light and power consists of four 4 by ¼-inch busses (one per leg) and enters the board through a 1000-amp. switch. Between transformer vault and main board, bars of unlike phase are transposed and re-



Extensive use is made of underfloor ducts for the distribution of light, power, and miscellaneous signal wiring. Single and double junction boxes are installed with partitions separating the lighting from the signalling sections. Cast brass covers are varied in thickness in accordance with the expected loads of equipment and industrial trucks.



Overnight, 1500 tons of paper are converted to a 1¼-million copy edition due to reliability of distribution system, a completely electrified newspaper plant, electronic controls and an efficient maintenance staff. No factor is more essential than electrical reliability. (Photo courtesy N. Y. Times)

grouped for minimum reactance losses.

With the addition of the 46 square inches contained in these four busbar services to the new board, the total cross section of incoming power feeders now approximates a square foot of copper.

Main feeders, controlled directly from the board, run to three 500 hp. air conditioning compressors, eight 160 hp. press motors, a 115 hp. high speed freight elevator and local power and lighting panels throughout the plant. Circuits from local panels travel to the numerous blowers, conveyors, elevators, ejectors, overhead doors, agitators, routers, saws, monotype machines, receptacles, lighting installations and pumps (fire, sump, circulation, vacuum, water, ink and kerosene) throughout the entire new, and parts of the older, buildings.

Some indication of the scope can be obtained from the bill of materials which includes 40 miles of galvanized conduit (¾ to 4-inches), 120 miles of wire and cable (No. 12 to 500 MCM), 5 miles of underfloor duct, 100 power and lighting panels controlling 1300 circuits ranging from 30 to 600 amps., 230 motors ranging up to 500 hp. in capacity, 1200 receptacles and three 1000-kva. transformers.

Extensive use is made of underfloor duct for the distribution of light, power and miscellaneous signal wiring. Fiber ducts are run 1¼ inches below floor levels and are fitted with threaded preset inserts, set flush with finished cement on 2-foot centers. Both single and double junction boxes are utilized, partitions separating the lighting from the signalling sections in the double units and duct elbows establishing connections to wall boxes. Covers of cast brass vary in thickness, depending upon the expected industrial truck loadings common to individual floors and departments. The system establishes flexibility for future departmental reorganization involving movement of partitions or relocation of equipment. The duct distribution was selected for neatness, convenience and accessibility.

To ground metal inserts of this fiber system, bare No. 12 wires are buried in floor slabs and establish a tie between inserts and pull boxes.

Vibration Reduction

To reduce the transmission of vibrations from one section to another, several mounting and construction methods are employed. Where vibrations can be confined or minimized at their source, thick rubber cushioning is placed beneath the bases of machines, control boards and motor-generators. An example of the successful application of this method is found in the overhead motor room of the 115 hp. 500 fpm. freight elevators. Since equipment is not directly in contact with the structural framework of the building, much of the operational vibration is confined to the local area through dissipation or absorption by the hard rubber mounting blocks beneath m-g set and controller. The treatment of the broadcasting studios offers another illustration where vibration is excluded from an area. The studio, of floating construction, is completely cushioned so that vibrations, imparted to the building framework from any cause within or from outside the building, are excluded from this location. Electrical outlets in this section are connected to the rigid distribution system by flexible conduit.

In planning the lighting layouts, fixtures were primarily selected to conform with the popular preference of the personnel in the area being lighted. Before expanding departments were moved into new quarters, a representative variety of lighting units were mounted in the original areas on a trial basis and delegations of employees visited other newspaper plants in the metropolitan area to observe the plans used by others in the same field. It was found that the employees placed more emphasis upon functionalism, local application and light quality than upon fixture design or overall uniformity of appearance, and expensive fixtures and high intensities of illumination were often set aside in favor of these other properties. In the case of the composing rooms, the suggestions of the employees led to the redesign of a standard fixture and the adoption of a new mounting method. After studying a wide range of units, both incandescent and fluorescent, and

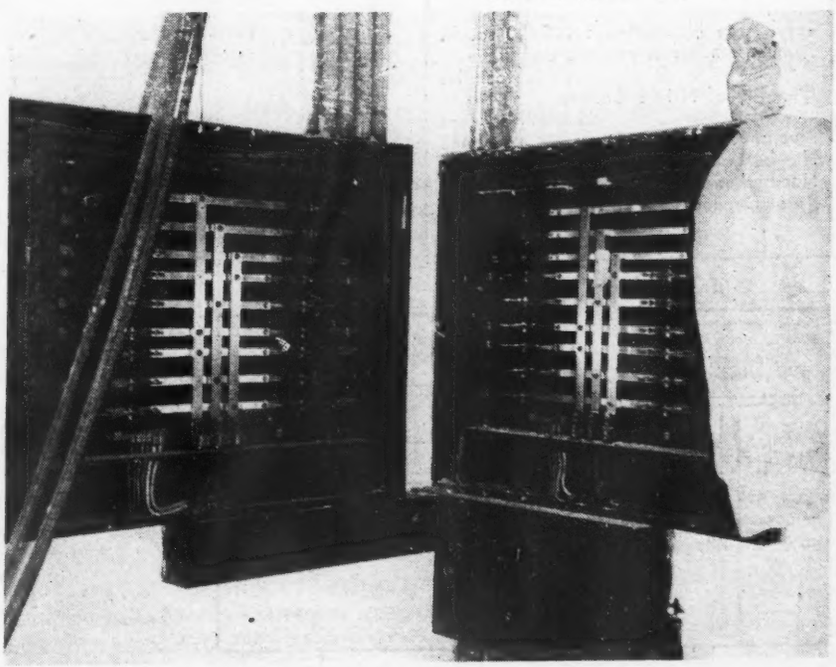
color combinations, the men voted for a unit consisting of a large diameter, shallow, pale-blue diffusing-glass bowl in a chromium frame, illuminated by a 300-watt incandescent lamp. Where installed in low-ceiling areas, the combination of diffused blue light passing through the glass and soft white light reflected from the ceiling was pleasing to the eye, ample for critical work (40 footcandles), minimized glare and gave excellent definition to type faces at working levels. In high-ceiling areas, however, where floor-to-fixture and fixture-to-ceiling measurements were varied, the desired color correction was upset and the intensity was less than desired upon work tables. As a solution, the bowls were suspended two feet below white plywood reflectors which, in turn, were suspended at the desired ceiling elevation. After several experimental installations, the shields were constructed so that approximately 80 percent of the upward light component was reflected while the remaining 20 percent illuminated the true ceiling to reduce the brightness ratio between the two overhead levels. The result was productive of favorable comments from visiting composing-room personnel and satisfaction on the part of the men working beneath these units. Lighting, throughout the building, is predominantly incandescent, with fluorescent lighting used principally for general illumination over aisles between presses and in certain office areas.

Illumination in composing area is furnished by high-wattage incandescent lamps shielded by pale blue glass bowls. Fixtures are stem-mounted beneath suspended rectangular reflection panels. Glare and shadows are at a minimum. (Photo courtesy N. Y. Times)

On-the-Spot Analysis

Many installation problems, unique to printing plants, were encountered during construction and were solved through on-the-spot analysis and by frequent conferences between contractor and maintenance engineer.

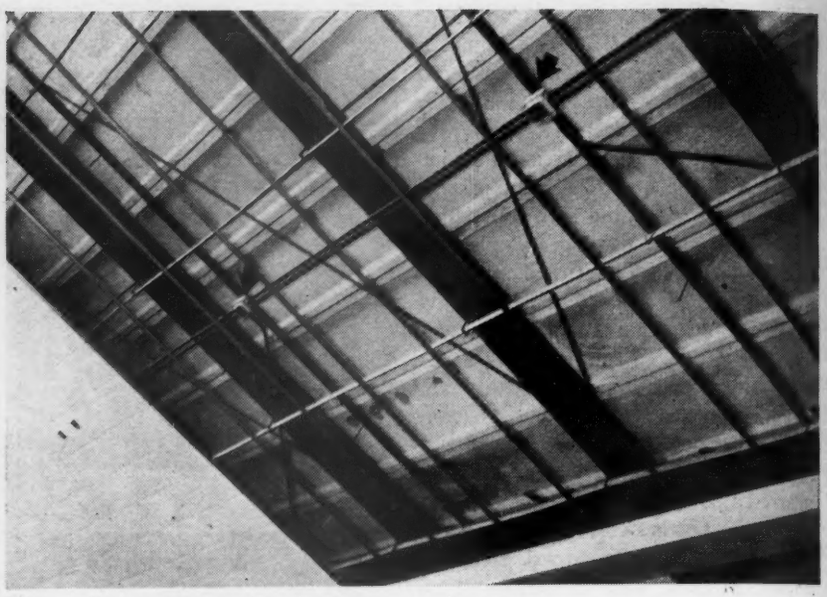
The completed distribution system of *The Times* represents a sound investment in "Deadline Insurance." Since maintaining maximum press schedules through hours of darkness demands guaranteed performance, the element of possible failure must be minimized by approving only the best in electrical distribution, control, protection and maintenance. To convert 1500 tons of paper from roll stock to 1¼-million newspapers overnight calls for a closely-integrated organization and absolute adherence to a rigid time schedule. That these performances are consistently upheld is the proof of continuous performance through electrical reliability.



Construction picture shows layout of stereotype department's main control panels. Risers from main switchboard enter bottom of boards. Branch feeders are carried through conduit connected to tops of panels. Branch feeders run to local control panels conveniently located.

Unique lighting layout and socket design permits interchange of Slimline and cold cathode lamps.

By William F. Schaibley
Brooker Electric Co.
Detroit, Mich.



View of circuit conduits and fixture channel supports (arrows) before ceiling was covered.

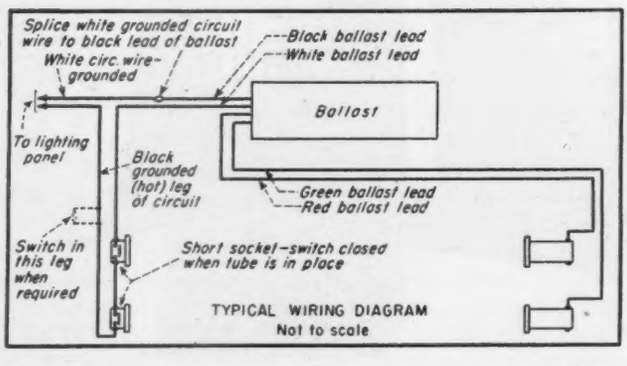
Convertible Slimline—Cold Cathode Lighting

INSTALLATION DATA

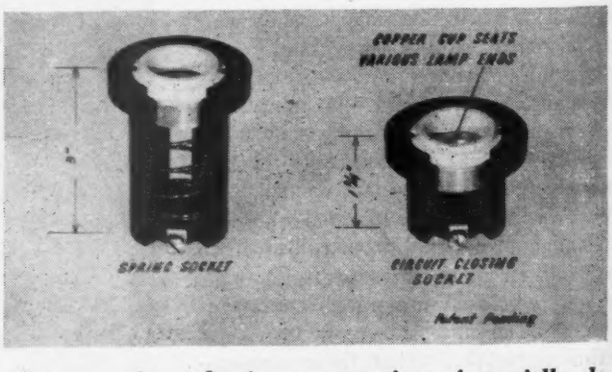
Total Area Illuminated	105,000 sq. ft.
Illumination Intensity on Working Plane	75 footcandles
Quantity of Fixture Channel	13,128 lineal feet
Number of Lampholders	13,688
Number of 93-inch Lamps	6,844
Number of 2-lamp Ballasts	3,422
Total Connected Lighting Load	363 kilowatts

SLIMLINE-COLD cathode lamp interchange is practical in the new engineering and administration building of Briggs Manufacturing Company, Detroit. Any of the present 6,844 hot cathode slimline lamps can be replaced by cold cathode lamps with equal facility. It is simply a lamp replacement chore.

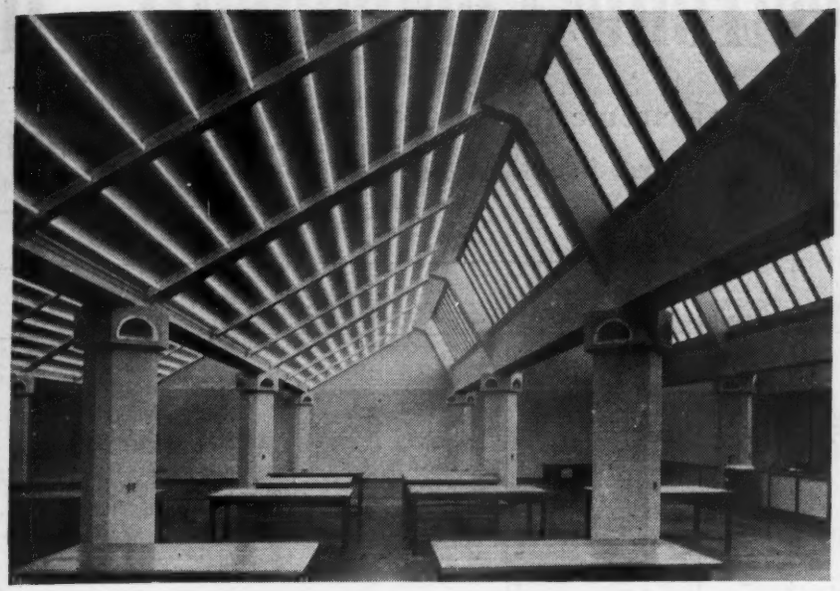
The two story structure is completely air-conditioned, 240-ft. by 350-ft. Layout limitations were imposed by a sawtooth (north light) roof construction and 20-ft. by 25-ft. bays. Briggs plant engineer, W. R. McClenaghan, and building designers, W. W. Wood Company, wanted a lighting system that would meet the exacting demands of critical office and engineering work. Both preferred the long light source of the slimline and cold cathode type and decided to install a system that


Splice white grounded circuit wire to black lead of ballast
White circ. wire-grounded
Black ballast lead
White ballast lead
Ballast
To lighting panel
Black grounded (hot) leg of circuit
Green ballast lead
Red ballast lead
Switch in this leg when required
Short socket—switch closed when tube is in place
TYPICAL WIRING DIAGRAM
Not to scale

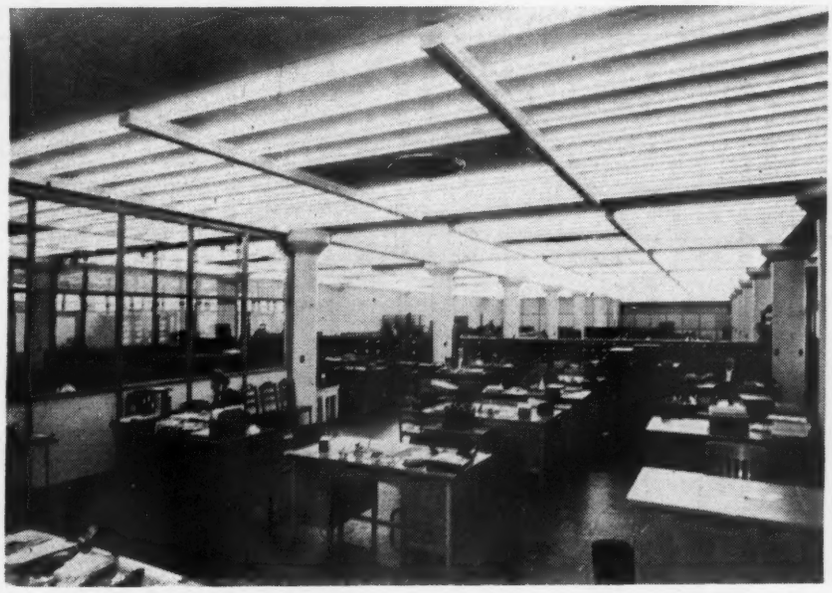
Typical circuit diagram of ballast and socket connections.



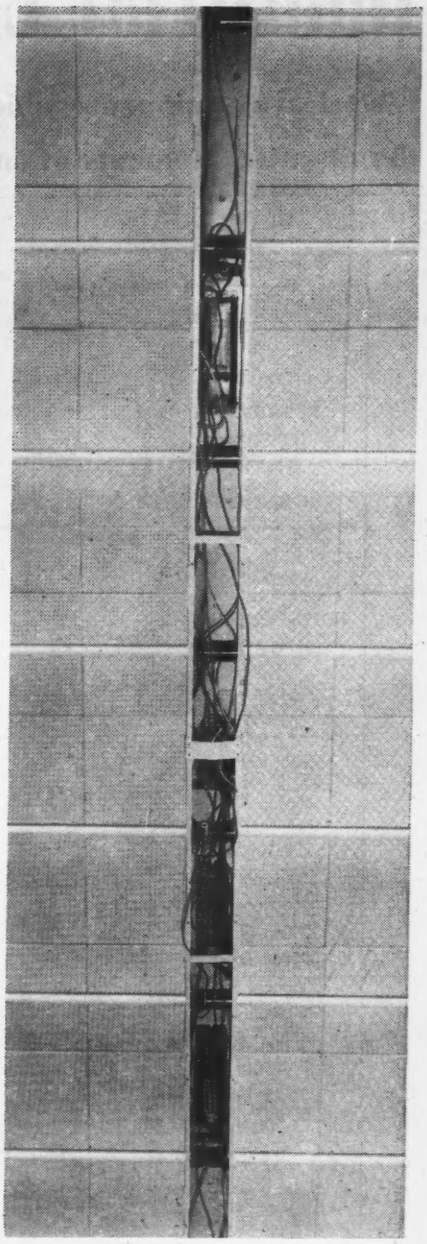
Cut-away views showing construction of specially designed "long" socket (left) and circuit-closing socket. Copper cups accommodate both Slimline and cold cathode lamps.



East-West view of saw-tooth bay in engineering area, showing illuminated "grid" of Slimline lamps. Combination with natural light provides even distribution on working plane.



General office area utilizes same illuminated "grid" unit. Light "stack-up" can be minimized by installing ceiling baffles at column lines.



Close-up of fixture channel mounted to saw-tooth ceiling. Note "long" and "short" sockets back to back and roominess of wiring channel.

would take either lamp. They gave Brooker Electric Co., Inc., Detroit electrical construction and engineering firm, the job to design and install such a system.

A full-size plywood model of two second floor saw-tooth bays was built for study. Suspended fixtures would not suit the structure so study was concentrated on ceiling mounted units.

One bay was equipped with four fixture channels containing a total of 30 hairpin-type cold cathode lamps spaced six inches between ends and 42 inches between centers of the hair-pins. The other bay was equipped with four channels containing 30 straight lamps spaced on 18-inch centers. Both provided the desired 75 footcandle intensity. Straight lamps were chosen because of the more even light distribution on the ceiling used as a reflector.

As finally installed, the second-floor system consists of an illuminated horizontal "grid" of 30 unshielded lamps (10 rows on 18-inch centers) per bay, mounted to the saw-tooth incline, the ceiling height at columns is 10-ft., 6-in.; at peak 16 ft. At column lines, a $4\frac{5}{8}$ inch space between end channels permits addition of partitions if desired. In effect, this arrangement provides an inverted triangular trough of combined artificial and natural light.

In the interest of fixture and lamp standardization, the same unit was used in the first floor general office areas. Here the "grid" was mounted to the 11-foot suspended acoustical ceiling. To provide space for ventilating outlets, two lamps were eliminated in the center of each bay, leaving 28 lamps per "grid."

Channel and Socket Design

Lack of standard lighting equipment that would satisfy the above design required development of fixture channels and lamp sockets. Space limitations

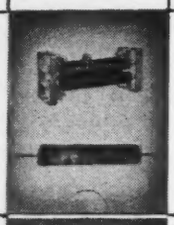
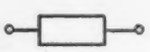
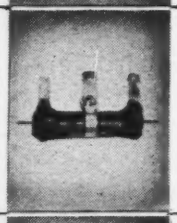
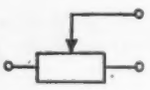
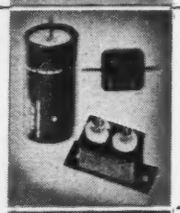
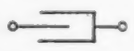
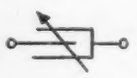
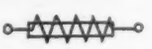
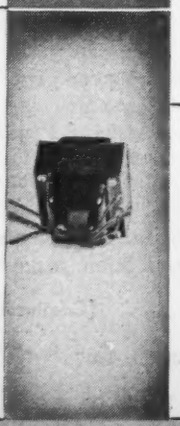
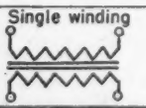
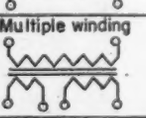
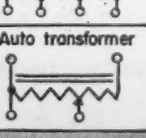
[Continued on page 190]

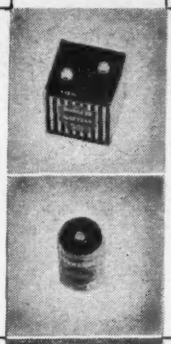
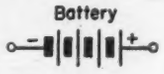
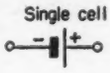
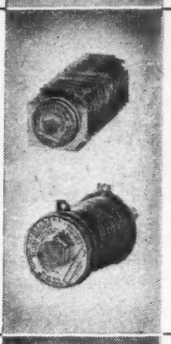
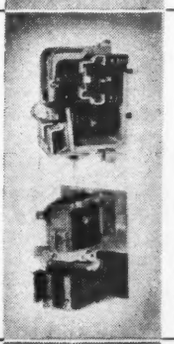
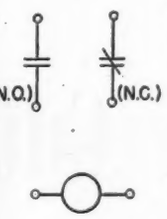
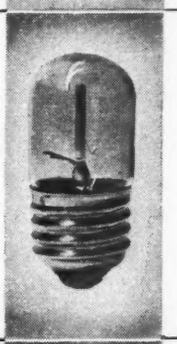
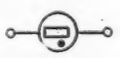
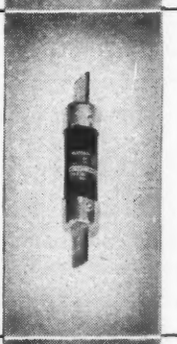
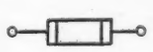
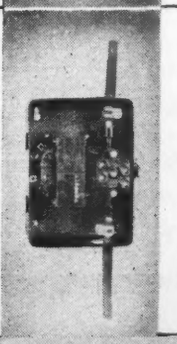
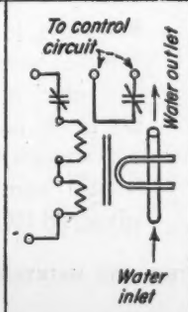
Industrial Electronic Components—II

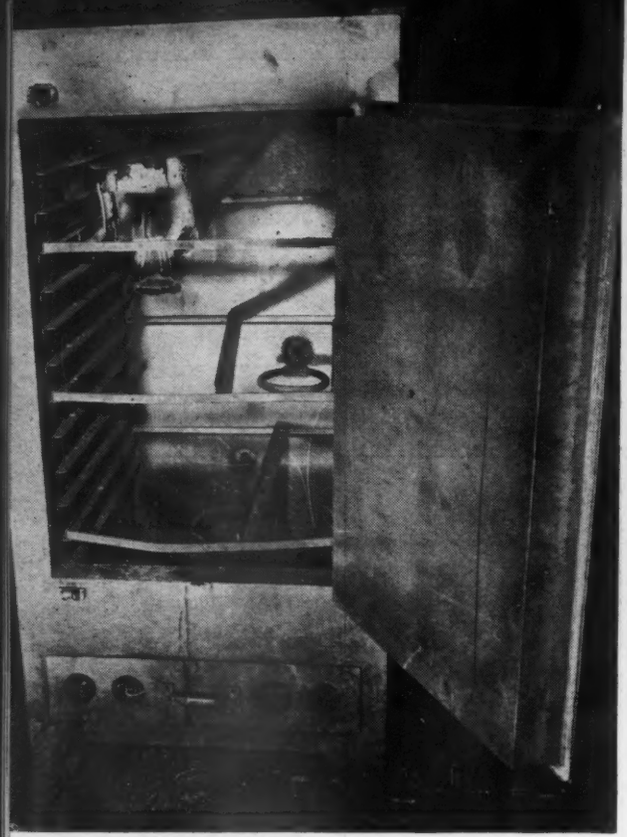
Electrical components which, with electronic tubes, are the essential elements of industrial electronic apparatus.

By R. B. Immel
Westinghouse Electric Co.

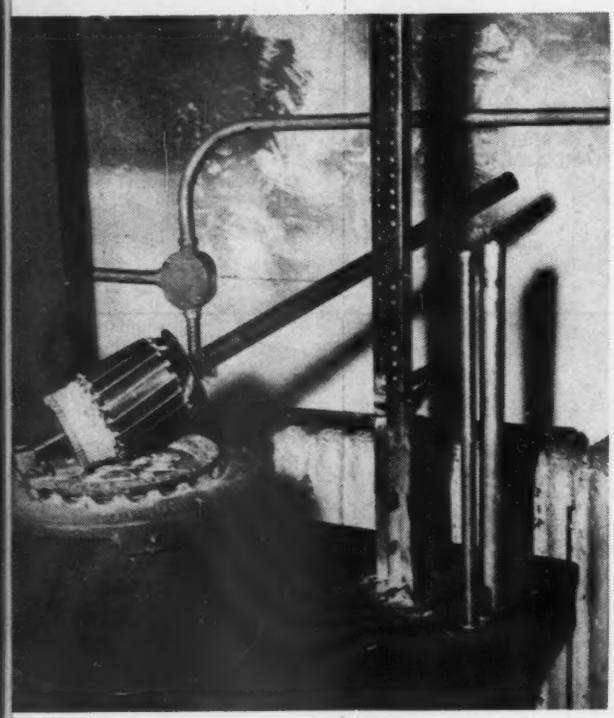
AUXILIARY APPARATUS

TERMINOLOGY	TYPICAL DEVICES	METHOD OF CONTROL	CHARACTER OF SPACE OR CONDUCTION MEDIUM	SYMBOL	FUNCTION	TYPICAL APPLICATIONS
RESISTOR (FIXED)		NONE	METALLIC		TO PROVIDE RESISTANCE	GRID CURRENT LIMITATION ANODE AND GRID POTENTIAL DIVISION LOAD IN RESISTANCE COUPLED AMPLIFIER ANODE CIRCUIT
POTENTIOMETER (VARIABLE)		MECHANICAL				
CONDENSER (CAPACITOR)		NONE	Dielectric between metallic plates may be in form of solid liquid, or gas.	Fixed 	TO PROVIDE CAPACITANCE	ENERGY STORAGE DEVICE FOR OSCILLATORS, TIME DELAY CIRCUITS AND WELDERS. FILTER PHASE CONTROL FREQUENCY COMPENSATION
		MECHANICAL		Variable 		
CHOKE OR INDUCTANCE (REACTOR)		NONE	METALLIC (Coil may have an air or iron core for electromagnetic conduction)	Air core	TO PROVIDE INDUCTANCE	ENERGY STORAGE DEVICE FOR TIME DELAY CIRCUIT. FILTER PHASE CONTROL FREQUENCY COMPENSATION
				Iron core 		
TRANSFORMER		TAP CONNECTION	METALLIC (Transformer coils are on iron core for good electromagnetic conduction)	Single winding  Multiple winding  Multi tapped Auto transformer 	VOLTAGE OR CURRENT TRANSFORMATION (A-C)	A-C RECTIFIER SUPPLY WELDING TRANSFORMER TUBE FILAMENT AND HEATER POWER SUPPLY CIRCUIT ISOLATION MISCELLANEOUS A-C POTENTIAL SUPPLY

TERMINOLOGY	TYPICAL DEVICES	METHOD OF CONTROL	CHARACTER OF SPACE OR CONDUCTION MEDIUM	SYMBOL	FUNCTION	TYPICAL APPLICATION
BATTERY AND CELLS		CELL CONNECTION	Cell electrolyte may be a liquid or a moist solid	Battery  Single cell 	SOURCE OF ELECTRICAL ENERGY (D-C)	ANODE AND GRID POTENTIAL SUPPLY HEATER OR FILAMENT POWER SOURCE FLASHLIGHT PORTABLE POWER SUPPLY
RECTIFIER (METAL OR DRY DISK)		NONE	METALLIC OXIDE		RECTIFICATION	D-C POWER SUPPLY BATTERY CHARGING BLOCKING CIRCUITS IGNITRON TUBE IGNITER CONTROL
RELAY		Coil voltage or current Adjustment of armature kick-out spring	METALLIC (Contacts may operate in an air, oil, or gaseous medium	 (N.O.) (N.C.)	SWITCHING	TRANSFER OF AN ELECTRICAL IMPULSE TO ONE OR MORE OTHER CIRCUITS AS ON AN ELECTRONIC TIMING DEVICE PHOTOTROLLER CONDENSER WELDING CONTROLLER
BALLAST OR CURRENT REGULATOR TUBE		Temperature of resistor element	METALLIC (Gaseous atmosphere surrounding resistor element provides heat conduction		CURRENT REGULATION	CURRENT REGULATOR FOR HEATERS AND FILAMENTS CONSTANT CURRENT SUPPLY FROM BATTERY
FUSE		NONE	METALLIC		CIRCUIT OVERLOAD PROTECTION AND CURRENT INTERRUPTION	CONTROL CIRCUIT PROTECTION POWER CIRCUIT PROTECTION IGNITRON TUBE IGNITER CIRCUIT PROTECTION
ELECTRO-THERMOSTATIC FLOW SWITCH		Temperature and rate of flow of cooling water	METALLIC AND WATER	 To control circuit Water outlet Water inlet	PREVENTION OF OR WARNING OF WATER COOLED TUBE OVERHEATING	OVERHEATING PROTECTION FOR IGNITRON TUBE



TRIPLE-DECK OVEN burns out stator windings while mechanic does other work. Automatically controlled Despatch unit has three staggered ring gas burners (4", 7" and 9" diameters) providing a low temperature carbonizing flame. Rated at 350 F., the oven will take up to a 5 hp. motor; has safety draft control that starts fan motor before burner will work. One side of coils are cut off before being placed in oven. Fractionals are left in unit ½ to 1 hour. Charred insulation and windings fall in removable drawer at bottom.



ANGLE-IRON "LADDER" welded to soldering bench holds armatures at an angle for soldering commutator connections. Steel pins inserted in holes (on 1½-in. centers) support conduit sleeve shaft extension. "Ladder" is 30 inches high; sleeves are 18 inches long and of diameters to take ½", ¾", and 1" shafts.

HAND REST WITH GUIDE pins on coil winding machine reduces physical and mental tension of operator; permits her to wind coils by "touch" while concentrating on turn counter. Pins form guide positions corresponding to 15 steps of winding head. Thumb and forefinger holds magnet wire on bar and in proper position while head is turning. Bar is ½-inch thin-wall conduit; pins are brass.

Cutting Shop Costs

By August Eckel

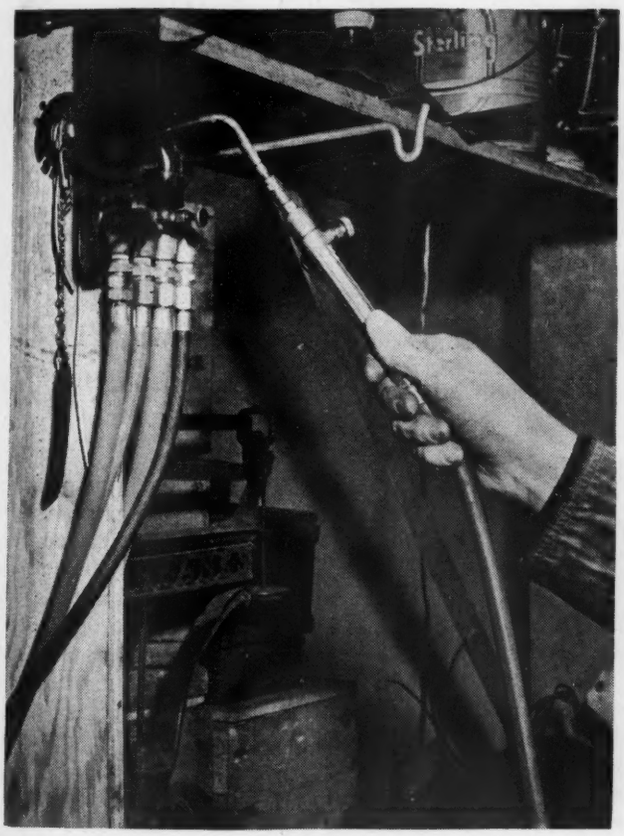
Some minor improvements that cut operating costs in Boustead Electric's small motor repair department.

Profitable operation of a small motor repair business is a direct function of shop efficiency. Best way to attain top rating is to set up a separate department with special equipment and trained personnel to handle fractionals. Unit cost reduction through a well planned shop layout and efficient repair and operating techniques paves the way to the volume production needed to earn a reasonable return.

George P. Svendsen, manager, Boustead Electric & Mfg. Co., Minneapolis, followed this pattern when organizing his small motor repair department. Not content with an already efficient layout, including latest equipment and trained personnel, he went on to improve it by concentrating on seemingly minor details. Some of the economical methods he used to cut minutes from the less spectacular shop chores are illustrated below. Minutes saved soon added up to hours. The resultant over-all shop efficiency permitted operating cost reductions that improved the profit picture.

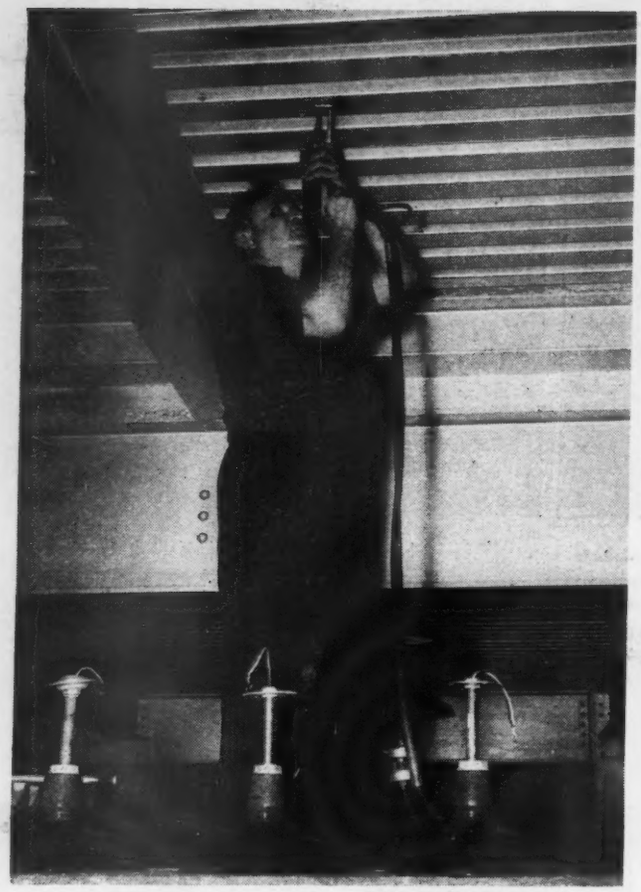
Although his new department is now in high gear, Svendsen is still scanning his operations to find other places where advanced techniques can be applied.

HALF-STEP CLIPS made from 5/8-in. copper strip are used on single-phase winding head when length of coil loop falls between conventional steps on head. Two sets of 15 clips each (Left) are kept in slotted rack. Each slot and clip is numbered to correspond to step numbers on head. Clips snap on corresponding step of winding head (Right, arrow). There is about one inch difference in total length of coil loop between normal steps on head; copper clips reduce this to one-half inch. Winding data cards indicate step numbers to use. A "2½" notation would indicate use of clip on step 2.

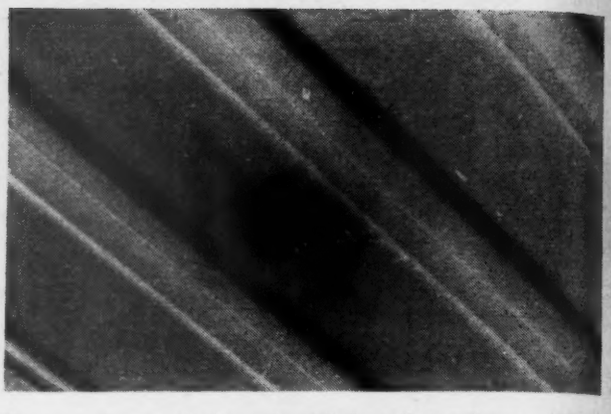


AUTOMATIC TORCH CONTROL saves time when using acetylene torch for making all Formvar magnet wire connections. This "gas economizer" is a gang coupling between tank and torch hoses with a built-in pilot flame and hook-arm valve. Torch on hook closes valve shutting off gas to nozzle; off hook opens valve. Pilot flame is for igniting torch. Gas cut-off at "economizer" eliminates former need of adjusting nozzle valves each time torch is used. One adjustment assures proper mixture at all times.

QUICK-CHANGE LABEL is placed on all new parts before going into shop. Label (Dennison's "Pres-A-Ply") can be reused several times without loosing adhesiveness. Mfgr's. part number, stock order number, name of part and rating are printed on label in ink. After assembler mounts part, he transfers label to job ticket. Shop clerk, in turn, transfers label to blue parts ticket which accompanies job ticket to office for pricing and perpetual inventory record. It then goes in monthly parts cost file. Method saves valuable mechanics time, eliminates re-entry errors, confines paper work to office clerical staff.



Access hole is cut in Q-floor cell. Studs are applied with stud welding tool shown above to take cover plate.



Closeup of access hole and welded studs in place. Wiring is pulled in from headers at end of the floor cells.

Splices are pushed up into cell and cover secured to the welded studs with hex nuts.

Welded Studs Support Fixtures

Covers fastened by welded studs provide direct fixture support from Q-floor wiring channel.

MORE than 500 incandescent lighting fixtures were installed by the Allegheny Electric Company of Pittsburgh from Q-floors without the use of any outlet boxes, grommets, or lock nuts usually employed for this purpose. The Q-floors form the ceiling for the first and second floors of the three-story Pittsburgh warehouse, recently erected for Union Supply Company, a United States Steel Corporation subsidiary.

The electrical contractor cut access holes in the raceway using a Black and Decker circular saw in a ½ inch drill. The drill was fastened to the end of a length of ¾ inch conduit. One man guided the drill from the scaffold. Another man on the floor using a piece of 2 to 4 as a fulcrum and another board as a lever supplied pressure by resting the end of the supporting conduit on one end of the board and stepping on the other. Thus cutting the access holes was a relatively simple and effortless task.

He then welded two ¼ inch threaded studs on either side at each fixture location. All wiring for the lighting system is carried directly in the floor channels, which form wireways. The fixtures are connected and the cover plates secured to the ceiling by means of the studs.

D. R. Ross, superintendent of construction for Allegheny Electric, reports that this simplified method reduced installation time approximately one-half hour per outlet and saved approximately 65 cents worth of materials per unit. The method used in the installation of these fixtures on 10-foot centers throughout an area totaling 32,000 square feet, resulted in a net saving to the owner of $1,115, according to Mr. Ross. A Nelson stud welding gun, with an automatic timer, was used in this installation.

The building is 80 by 200 feet, and is of structural steel construction, with sidewalls of concrete block, faced on the exterior by common brick. David T. Riffle, Inc., was general contractor on the project, which was designed by J. Phillips Davis, architect, and Elwood Tower, consulting engineer.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods

Flexible Connections For Sales Counters

MERCHANDISING

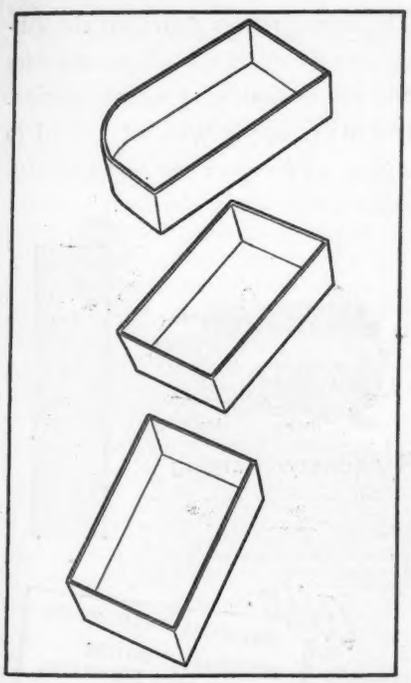
A new merchandising trend in modern department stores is towards flexibility of showcase and sales counter arrangement. Counter layouts are changed in accordance with the demands of seasonal displays. Departments are expanded and contracted as sales requirements dictate. Traffic is diverted to different areas of stores by relocating aisles and shifting the various displays and cases.

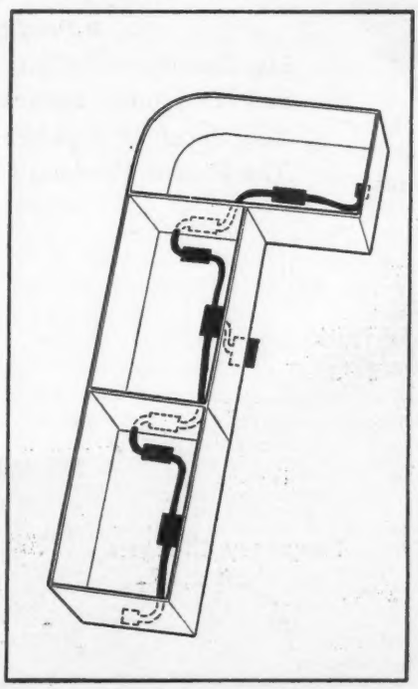
This versatility is possible by connecting counters and displays to one another by means of flexible connectors. Only a single unit in each group of counters need be connected to a floor box and the remaining counters, chain-connected to this fixed unit, can be swung into a variety of merchandising arrangements to best accommodate seasonal demands.

In designing Lane Bryant's new Fifth Avenue store for women in New York City, consulting engineer Edward E. Ashley provided for a flexible arrangement by specifying a complete installation of connectors, plugs, jumpers and fittings designed for flexible interconnection of counters and show cases. The fittings and accessories, designed and manufactured by Russell & Stoll, include metallic-sheathed wiring to provide for the carrying of the building ground system to each case and fixture, steel-clad connectors and plugs, and self-aligning machined contacts.

Two methods of application can be used, connecting key showcases to either floor boxes or to underfloor ducts. These two methods are illustrated in the accompanying drawings.

It is expected that variety of counter arrangement, combined with varied lighting treatments, will aid in promoting sales by increasing customer interest. Counters may be shifted independently of any existing underfloor distribution grid and maintenance should be retained at a minimum.





Individual show cases and sales counters can be quickly connected to one another by means of flexible metal-sheathed cables and the accessories illustrated. This flexibility will permit rearranging counters in accordance with seeasonal demands.

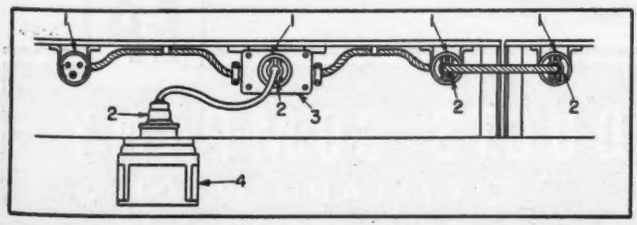
Panel Wiring Made Easy

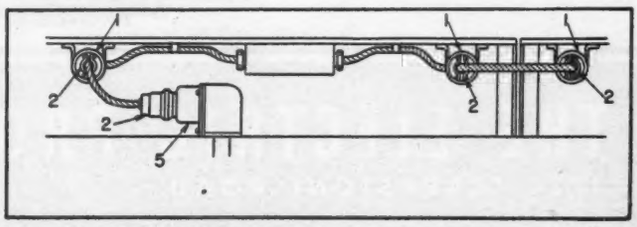
WIRING

It's a cinch to wire, and maintain, the lighting distribution panels that Kvalsten Electric Company, Minneapolis electrical contractors, recently installed during electrical distribution alterations and extensions at The Dayton Company department store in Minneapolis.

Kvalsten engineers assured such installation and maintenance ease when they specified three new features when ordering the panels:

1. Extra wide wiring gutters. Panel cabinets are three inches wider on each

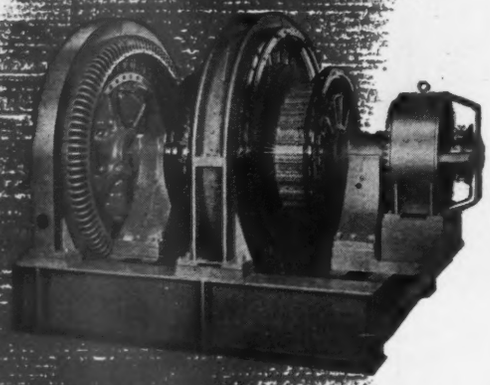




1. FEMALE RECEPTACLE 2. MALE PLUG 3. CONNECTING BOX 4. FLOOR BOX 5. EVER-LOK FLOOR EXTENSION

"Matched-to-the-Job" Performance...

ASSURED BY EP SPECIALIZATION

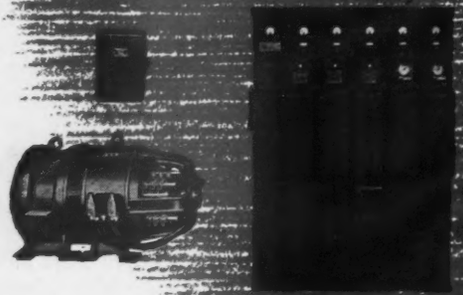


For Electrolytic Processes

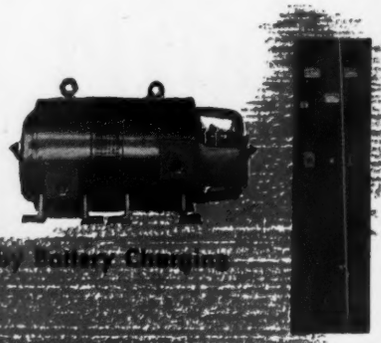
• *Every piece* of EP equipment is designed and built for its specific application. This factor of specialization . . . building-for-the-job, is the reason why The Electric Products Company is the leader in its field. For 35 years, EP has been building High-Current, Low-Voltage Motor-Generators and other special electrical equipment.

• *To You* as a user of direct-current in any of its applications, our specialized equipment means savings in life-time cost per unit. It also means more amperes per dollar ...less electricity consumed. Specially-built equipment requires far less maintenance . . . another saving in time and money.

• *Proof* of EP superiority is yours for the asking. Descriptive bulletins covering any of the illustrated uses and many other applications are available at no obligation. Your local EP representative will supply you, or a card to The Electric Products Company will secure the same results.



For Industrial Truck Battery Charging



For Stand-By Battery Charging

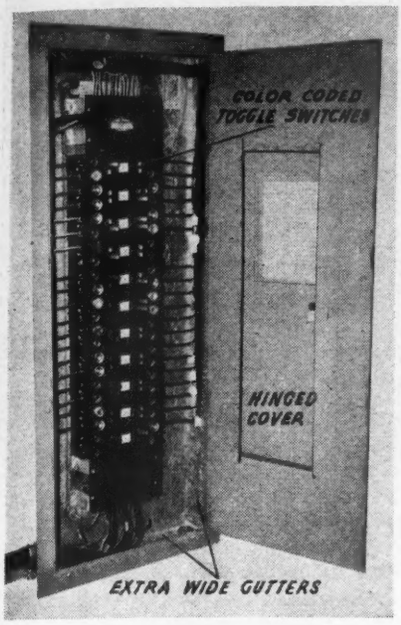
Frequency Changers

Also
INDUSTRIAL DYNAMOMETERS
SYNCHRONOUS MOTORS AND GENERATORS
SPECIAL MOTORS AND GENERATORS

EP X-84

THE ELECTRIC PRODUCTS COMPANY
1734 CLARKSTONE ROAD CLEVELAND 12, OHIO

side and five inches wider on top and bottom than the conventional "tub" for comparable panel sizes. Electricians are



A lighting distribution panel that is easy to install and maintain. Features noted below were specified by Kvalsten Electric Company, Minneapolis electrical contractors, for all panels in their Dayton Company store wiring project.

assured plenty of room to make wide sweeps of feeder cables and neat branch circuit connections.

2. Full hinged cover that exposes wiring gutters when opened. No longer need the maintenance electrician struggle with cumbersome screw-catch covers that must be completely removed to reach circuit connections. A hinged door in the cover gives operating personnel access only to fuses and toggle switches.

3. Colored toggle switch levers to assure correct balancing of the load on the 3-phase, 4-wire system. Red switches are on phase "A", yellow on phase "B", and blue on phase "C". Circuit additions or rearrangement can quickly be made without fear of creating an unbalanced condition.

Bearing Installed Using Dry Ice

MAINTENANCE

From Spartanburg, South Carolina, comes an idea for installing bearings without the use of a press. For installation crews, working under the same conditions encountered by A. W. Robinson of the Southern Electric Service Company, the method should be of interest and assistance. A letter from the Palmetto State puts the subject on ice by telling us that:

"They purchased a factory bearing from us a short time ago for a Westinghouse 40 hp., 900 rpm., Type CS motor, which we furnished several years ago. In placing the bearing in the end shield, they were faced with the obstacle of a very tight fit in the housing and no press available to force the bearing into place. They considered driving the bearing in place, using a sleeve of the same diameter as the bearing; however, this method was not used for fear of damaging the bearing.

"The bearing was then filled with dry ice and allowed to cool for a few minutes. It was then slipped into place in the end shield by hand. Approximately a half hour later the motor was reassembled and operated satisfactorily."

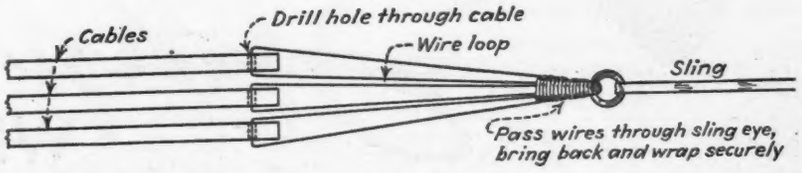
Easy Way To Pull Cable

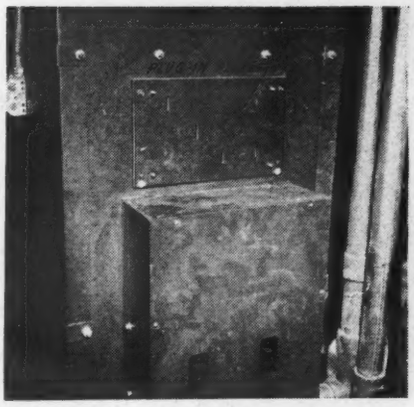
WIRING

"For pulling cable from No. 0 up to 1,000,000 C.M., we simply drill a hole through the cable near the end, run a wire through the hole and pass the ends of the loop so formed through the eye of the sling, bringing them back and winding them around on themselves several times securely," said H. R. Buzzell, assistant general manager of the Superior Electric Works, Los Angeles.

"With an electric drill and a size of wire appropriate to the pull required, this takes almost no time at all as contrasted with stripping the end of the cable and preparing it for some means of applying a fishing tape. Moreover, there is no waste of cable as compared with the stripping method, when frequently it is necessary to dig out a large section of the core in order to reduce its size for the application of a clamp or other pulling connection.

"For three phase circuits, the three cables can be pulled at once as shown in the sketch below. Obviously, a single cable can be pulled even more expeditiously by the same method."





Unique flexibility feature of vertical bus duct distribution system at The Dayton Company Store in Minneapolis is the extra plug-in opening in risers at each floor. Here, asbestos cover is removed to show access slots on a 4,000-amp., 250-volt, 4-pole (3-phase, 4-wire system) duct riser that is part of the system installed by the Kvalsten Electric Company, Inc., Minneapolis electrical contractors. Access plate accommodates dual tap-off unit (two, 100-amp., 250-volt, 3-pole circuit breakers), similar to one below, that can be installed without "killing" riser. Only breakers with proper subfeeder protection can be used. Scheme provides quick method of adding extra distribution facilities for special merchandise displays or permanent load increases.

Narrow Panels Fit Structural Columns

INDUSTRIAL

Local electrical control in the shop sections of Johns-Manville's new research plant near Bound Brook, New Jersey, is from narrow panelboards mounted between the flanges of structural H-columns in the high-bay areas. These panelboards, manufactured in several widths to conform with web dimensions of standard columns, are mounted at conventional heights. Extension troughs are carried up columns to connect panelboards with overhead pull boxes. Shorter wiring times have resulted and shorter branch runs are possible. The installations are neat in appearance, require minimum space, are protected by the heavy column flanges and locate control centers where most convenient. Equipment controlled

Where Toughness Counts

TIREX CABLES PAY OFF!

The ability of an insulated cable to withstand excessive punishment can mean a big difference in the output of portable equipment.

That's why Simplex-TIREX cables are specified over and again for use on heavy duty machinery such as the Barber-Greene Coal Loader pictured above.

Constant abrasion by those jagged lumps of coal and the crushing wheels of trucks demands a toughness that can be relied upon. Exposure to burning sun or heavy rains, to grease and oil demands protection that's both effective and lasting.

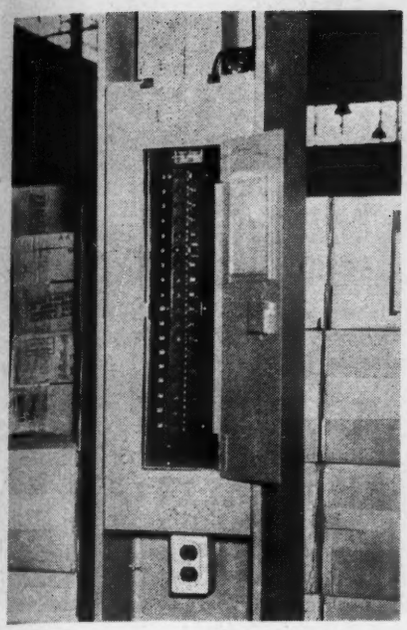
The cured-in-lead Selenium Neoprene Armor on all TIREX cords and cables is an exclusive compound carefully designed and manufactured to provide these features. It exceeds the requirements of the flame-resisting tests of the Underwriters' Laboratories and the Department of Mines, Commonwealth of Pennsylvania. Tests in the factory and field have proved it unexcelled by any other cord or cable jacket. When you specify TIREX, it is your assurance of efficient, dependable performance under any and all conditions.

If cable failures are slowing down your production lines and necessitating expensive repairs and replacements, we urge you to try TIREX cables at once. There is a size and type to meet the requirements for all portable cable service in mines, factories, repair shops, and construction operations.

TIREX cords and cables, in many sizes, can now be supplied direct from stock. Sizes not in stock can be shipped reasonably soon after your order is received.

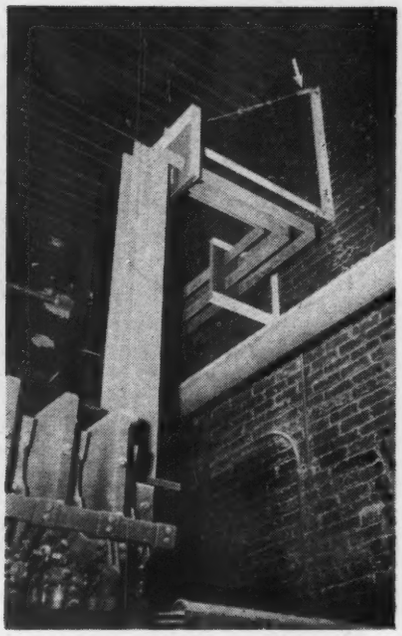
Simplex WIRES & CABLES

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.



Narrow panelboards fit between flanges of standard structural H-columns in Johns-Manville's research plant factory area. Convenience, safety, minimum space requirements and reduced installation time result from using these boards.

Stout floor flanges resting on concrete pads support weight of heavy bus duct risers at each floor in the 12-story Dayton Company Store in Minneapolis. Leveling bolts are adjusted before pad is poured. Duct is not ventilated where it passes through floor.



Spring tie-bracket (arrow) on busbar support relieves stresses at switchboard terminals caused by expansion or contraction of the copper bars. Turnbuckle adjusts initial length of steel cable and levels the ebony asbestos busbar support.

from these panelboards is powered from a 1000-amp. plug-in busduct that extends the length of the shop and is mounted at a height of 20 feet to the panelboard-supporting columns. Single phase 37.5 kva. dry transformers are connected to this busduct to transform the 3-phase 440-volt current to 120/240 volts.

Floor Supports For Heavy Vertical Ducts

WIRING

Design of adequate supports for heavy bus ducts was one of the biggest problems encountered by Kvalsten Electric Co., Inc., Minneapolis electrical contractors, when they installed a unique vertical bus duct distribution system to serve the 12-story Dayton Company Store in Minneapolis. Capacity of the various risers ranged from 1,000 to 4,000 amperes with most of the duct being 4-pole to provide both power and lighting on a 3-phase, 4-wire, 120/208-volt system.

Floor supports composed of angle-iron "arms" resting on concrete pads was the answer. Typical of those installed throughout the store is that illustrated in the accompanying photograph. Here, two 20-inch lengths of 4 in. by 4 in. by ¼ in. angle-iron were bolted to the sides of the 2,000-amp., 4-pole, busduct (16 in. by 12⅛ in.) Each of these floor flanges has two ½-in. cap screw bolts (resting on small steel pads) for leveling the duct after it is installed. After the riser has been leveled, concrete pads are poured between the angle-iron and the rough floor (height of pad varies with finished floor level but one inch is minimum). These pads take the full weight of the vertical duct sections.

At each floor, individual busbar weight is supported by Bakelite stop-blocks equipped with cap screw bolts and shake-proof washers. Also added as an integral part of the duct assembly at floor line is a Canvas-Bakelite barrier or "fire-stop" around the busses to prevent the duct from acting as a flue in the case of fire.

Spring Suspension Busbar Support

WIRING

To reduce physical stresses on long vertical bus connections to the main switchboard at the Sherwin-Williams Kensington Plant, Sweningson & Company, Chicago electrical contractor-engineers, designed a simple, yet effective, spring suspension support.

The bracket is fabricated from an L-shaped length of angle-iron with a steel cable and spring tie between the two free ends. One leg of the bracket is bolted to the wall high above the board. Mounted at the end of the other leg (where the busbars shift to a horizontal plane) is an angle-iron frame accommodating ebony asbestos busbar supports and spacers.

A turnbuckle in the steel cable tie provide the necessary adjustment to level the busbars before connection to the switchboard. The spring absorbs any stresses that may be caused by expansion or contraction of copper bars or vibrations in generator room.

By using this simple device, Sweningson engineers have eliminated trouble that frequently arises when stresses occur at the switchboard busbar terminals.

Active in construction management in the Tri-Cities area are: (L to R) G. O. Farlow (Farlow Electric Co.), East Moline, Ill.; Wm. J. McNealy (Electric Construction Co.), president, Tri-Cities Electric Institute, Rock Island, Ill.; and E. H. Ankerson (Schlueter Electric Co.), president, Quad Cities Chapter, NECA, Davenport, Iowa.

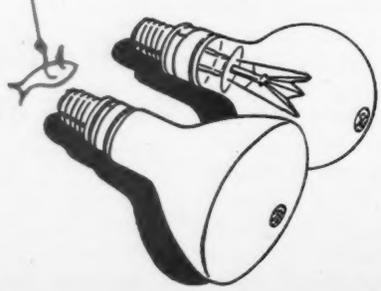
4 men in a boat

GRAHAM MacD. is a bright, young architect who's angling for a partnership. His big opportunity is the lighting layout for a new tractor plant. The question is—what light source is flexible enough to provide modern illumination for both offices and shops, and do it economically?

SOLUTION: You don't have to look far for the answer, Graham. General Electric fluorescent lamps have already set the pace in up-to-the-minute industrial lighting. Scientifically installed, they always improve plant efficiency and make work safer and easier.

ROBERT B. is a busy process engineer in a ceramic plant. He's fishing for a low cost production-line method of drying molded clay products so they can be handled more quickly. And he needs equipment that will fit right into his present plant layout.

SOLUTION: Have you checked with a recognized infrared oven manufacturer, Bob? He can fix you up with heating equipment tailor-made to do your special job. Be sure to specify G-E industrial infrared lamps. They're made in every size—from 125 to 1000 watts—to give you exactly the heat you need.



Whatever lamps you need

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising department, tell them in what issue of ELECTRICAL CONSTRUCTION and MAINTENANCE you saw the item and they will send full details to you.

Equipment News

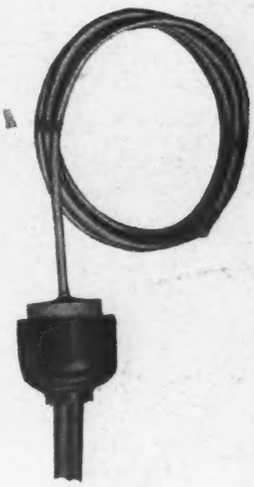
Synchronous Motors

To meet the needs of industries such as pulp and paper requiring splash-proof synchronous motors, this line of low speed synchronous motors has been redesigned to include splashproof construction. Simple design of end shield covers makes it easy to remove and assemble when inspecting motor. The pedestal bearings are outside the housing, permitting regular inspection of oil supply and oil ring operations. The new frame construction saves floor space as it has louvered openings for the side air discharge instead of the flared-skirt type of opening. The conduit box is included in the frame structure of the motor to protect it from splashing liquids. An inspection window is provided in the air chute. General Electric Company, Schenectady, N. Y.

G-E SYNCHRONOUS MOTOR

Alarm Switch

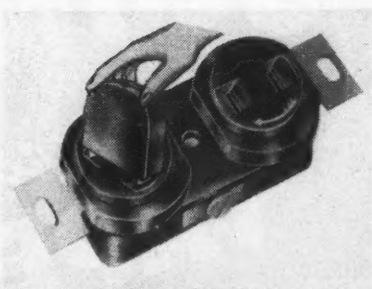
A new low voltage electrical alarm switch designed to warn of mechanical difficulties in commercial and home freezers has been announced. Installed with either a bell, light or buzzer alarm device, the switch is designed to function as soon as the temperature in the freezer rises to a predetermined danger point. The alarm device begins to operate while the interior temperature is still relatively low thus providing a reasonable period of time for emergency repairs before food spoilage starts. It contains a complete thermostatic element together with the contact mechanism. Cutler-Hammer, Inc., 228 North 12th Street, Milwaukee 1, Wis.



CUTLER-HAMMER SWITCH

Shock-Proof Receptacle

A new duplex receptacle features a self-closing rotary dial cap which covers access to current carrying prongs when receptacle is not in use. Particularly adaptable to residential use, it keeps children from inserting pins, wires or other metal objects; keeps out dirt, dust and water; reduces accident and short-circuit hazard in the home. Cord plug must be rotated a quarter turn to the right before contact is made. Spring action prevents plug from falling out; dial cup snaps closed when plug is withdrawn. Construction features rust-proof metal parts, large contact area, double walls of bakelite to isolate current carrying parts. Receptacle carries Underwriters label, is available in brown or ivory with plaster ears and twin binding screws. Bell Electric Company, 1844-50 West 21st St., Chicago 8, Illinois.



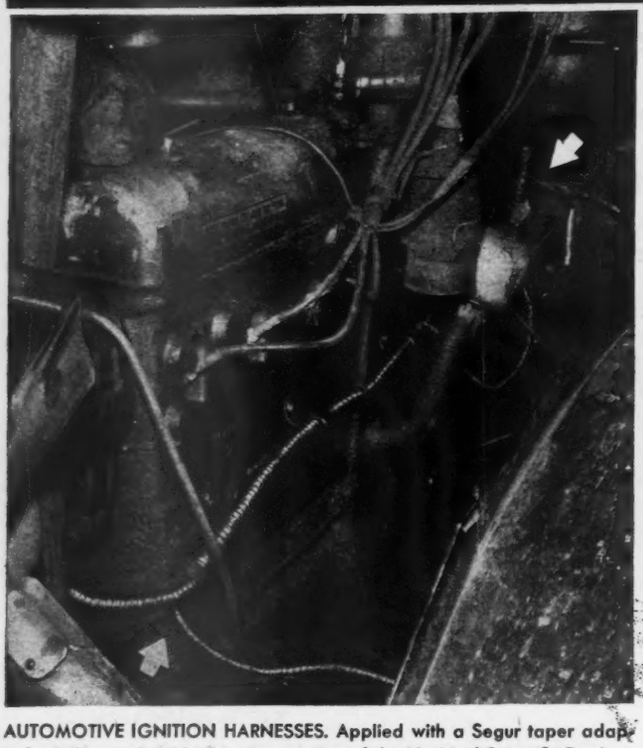
BELL RECEPTACLE

Electronic Intercommunication System

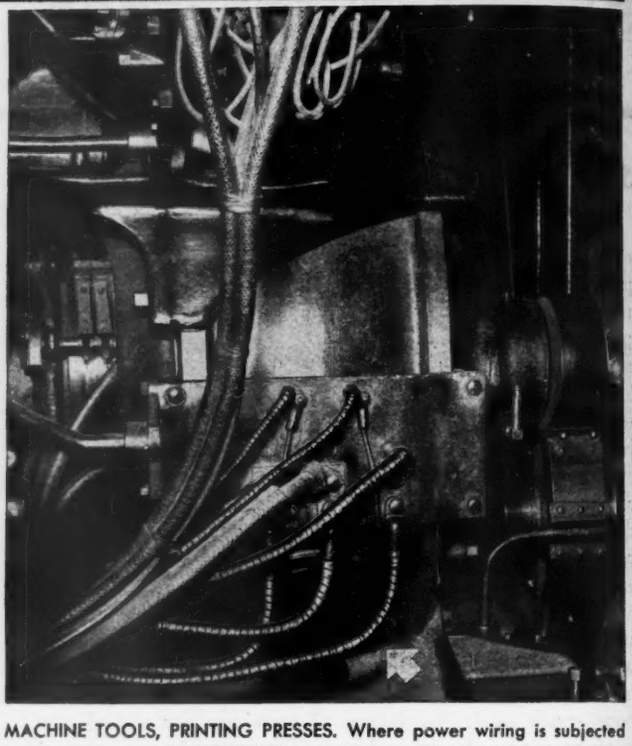
A new type of Amplicall electronic intercommunication system has been announced. The master station unit is available with or without handset, for completely private conversation. New features include "visual" busy signal, individual locking-type pushbuttons for station selection, illuminated "on-off" volume control, plug in cable connections, and a balanced line wiring system which prevents "cross-talk". Systems are available with facilities for the use of up to 24 master stations, permitting as many as 12 conversations to be carried on simultaneously. Rauland Corporation, 4245 N. Knox Avenue, Chicago, Ill.

RAULAND INTERCOMMUNICATION SYSTEM

FOR THE MOST EXACTING ELECTRICAL INSTALLATIONS



AUTOMOTIVE IGNITION HARNESSES. Applied with a Segur taper adapted to the work with the cooperation of the National Scientific Products Co. Applied in this manner "SCOTCH" Electrical Tape with Vinyl Plastic Backing makes a securely bound but flexible harness; high resistance to oil, water, alcohol, heat, abrasion; high tensile strength.



MACHINE TOOLS, PRINTING PRESSES. Where power wiring is subjected to oil, acids, etc., "SCOTCH" Electrical Tape with Vinyl Plastic Backing provides dependable resistance to oil; water, fresh or salt; acids; alkalis; alcohol; hydrocarbons.

PROTECTIVE SHEATH FOR BATTERY CABLES. Above picture shows heavy battery cables protected with a tight spiral-wound sheath of "SCOTCH" Electrical Tape with Vinyl Plastic Backing. The acid and oil resistant qualities of this tape equip it to give fullest electrical and mechanical protection.

REG. U. S. PAT. OFF.

SCOTCH BRAND Electrical TAPE

WITH VINYL PLASTIC BACKING

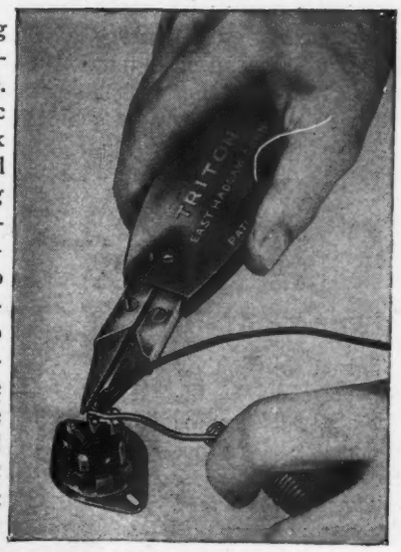
LISTED UNDER REEXAMINATION SERVICE UNDERWRITERS' LABORATORIES, INC. UL

"SCOTCH" is the registered trademark for the more than 100 varieties of adhesive tapes made in U. S. A. by

MINNESOTA MINING & MFG. CO.
THE 3M COMPANY
SAINT PAUL 6, MINNESOTA

Soldering Tool

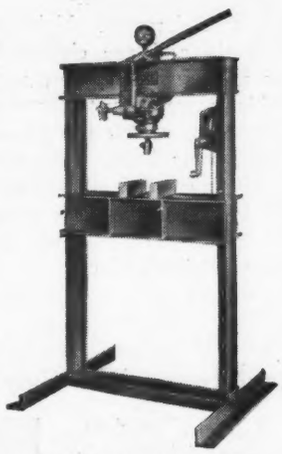
A new soldering tool, called Pres-to-Heat, is now available. It operates from a-c current, using a six volt transformer and a light weight heating unit. A spring-actuated lever, when compressed, closes two plier-like carbon electrodes on the parts to be soldered. By further compressing the actuating lever, the current is switched on for the short period required to melt the solder. Slightly releasing the lever turns off the current and permits the work to be held between the jaws until the solder has cooled. Triton Mfg. Co., Inc., E. Haddam, Conn.



TRITON SOLDERING TOOL

Hydraulic Press

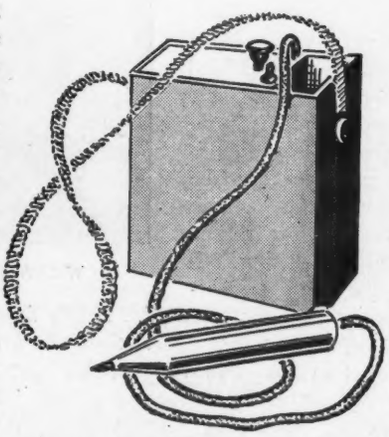
A new 25-ton hydraulic press, known as Model 25H, has been announced. It is built for use in maintenance, service, and industrial plants. Press features a fast moving ram saving considerable operating time, is claimed by the manufacturer. A large space between uprights allows the handling of work up to 33½ inches in diameter. Standard equipment includes two combination table and V-blocks, round nose for pressing, pressure gauge and table-hoisting mechanism. Dake Engine Company, Grand Haven, Mich.



DAKE HYDRAULIC PRESS

Neon Tester

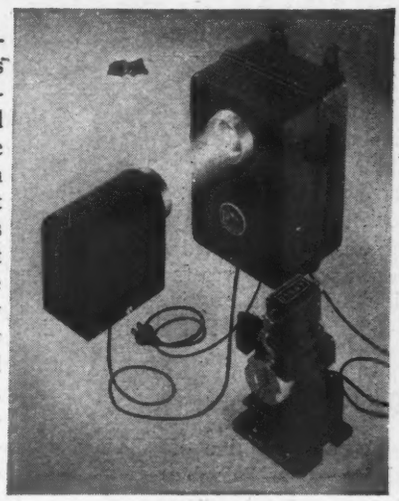
The Moonbeam neon tester, is a device for the neon service man and also for maintenance men on cold cathode lighting in offices, schools, factories, churches, etc. It is claimed to make the job of locating bad tubes and lamps faster, safer and easier. It is powered by a 45 volt B battery making it portable. The tester operates by means of creating a spark of 75,000 volts at low amperage, which activates the gas in neon and cold cathode tubes. Any undamaged tube will light instantly on contact. Tubes which fail to show light are either broken or burned out. If all tubes activate but the display fails to operate, it is an indication of trouble somewhere else in the circuit, such as switch, connections, transformers or fuses. The Lunar Products Company, 10238 Mack Avenue, Detroit, Mich.



LUNAR NEON TESTER

Electric Counter

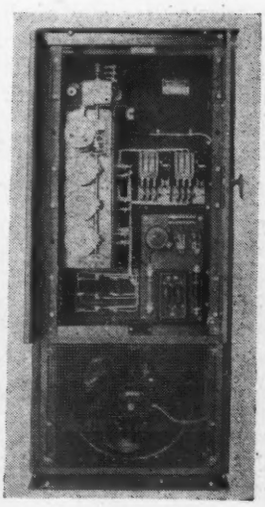
Photoelectric counter Type P1 consists of a photoelectric control, light source, and electric counter. The only equipment which needs to be located at the point-of-count is the control and light source. One or more electric counters may be placed at any convenient location and wired to the control. Remote control is easily obtained. No wiring is necessary. The control has a line cord which fits any standard lighting outlet. This supplies the power for the light source and electric counter, which in turn have cables and plugs for plug-in connection to the control. It is recommended for counting on loading chutes and conveyors, for remote counting, for high speed counting in can and box manufacturing, for counting small objects and many other applications. Photoswitch Incorporated, 77 Broadway, Cambridge 42, Mass.



PHOTOSWITCH COUNTER

Automatic A-C Control

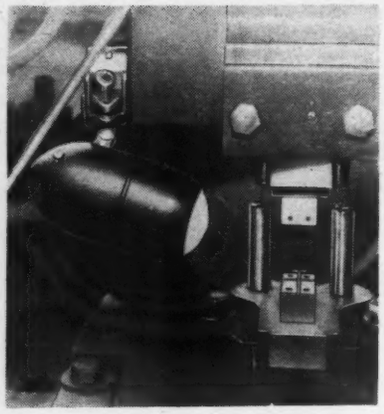
A new fully-automatic printing press control providing safe and accurate operation of newspaper presses has been announced. Composed of a unit substation, primary panel, and secondary cubicle, the new control can be used with a-c drives of 60 to 200 hp. All functions of the control are selected by the operator from pushbutton stations in the press room. The factory-wired unit substation contains transformer, circuit breakers, disconnect switches, and busses to supply the correct a-c voltage to the drive system. The primary panel dispatches power to the various units in the press-drive system in response to signals from the pushbuttons. The secondary cubicle regulates the speed. All parts are protected in a totally-enclosed case. General Electric Co., Schenectady, N. Y.



G-E CONTROL

Industrial Spotlight

A new industrial spotlight is now available. It consists of a steel shell into which has been mounted a rugged key type socket. The front end of the shell contains a powerful lens which concentrates the light directly where it is required. Louvres, both top and bottom, provide adequate ventilation while internal shields prevent stray light from showing through the louvres.

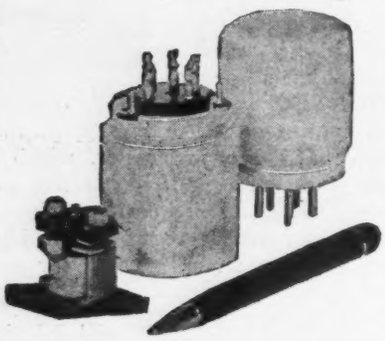


MAIN SPOTLIGHT

The light is mounted on a ball socket joint which will hold in any position. This light is recommended for use over bench grinders, lathes, punch presses, riveters and so forth where a high degree of illumination is required. Main Electric Company, Inc., 1462 East Main St., Rochester 2, N. Y.

D-C Relays

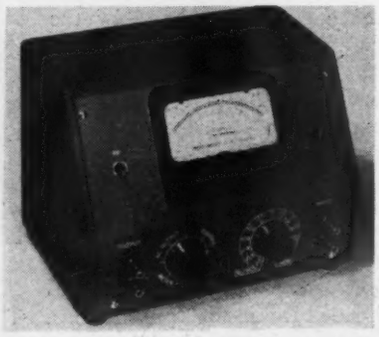
A complete line of single pole, double throw, current sensitive, d-c relays has been announced. The relays are designed for electronic applications where switching must be performed by amounts of power as small as 10 milliwatts. Input ratings for the eight types of relays in the line range from 10 to 180 milliwatts; 0.47 to 1470 milliamps; and 0.07 to 67,000 ohms. A relay of minimum size and weight can be selected for any of these coil power inputs. Contact voltage ratings range from 12 to 110 volts, a-c or d-c. At 24 volts d-c the contacts will handle two amperes non-inductive, or .05 amperes inductive. Relays can be provided with solder lug or plug in terminals. General Electric Company, Schenectady, N. Y.



G-E RELAY

Instrument

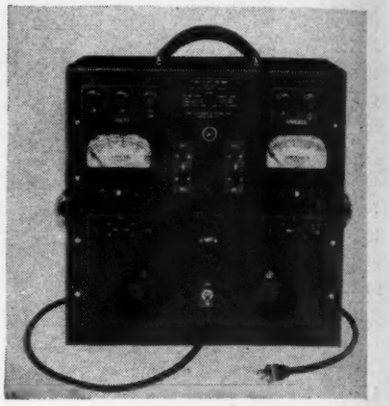
The new Model 47 voltmeter is a sensitive amplifier type instrument, featuring the voltage range of 50 microvolts to 500 volts accurate within plus or minus 2 percent from 15 cycles to 30 kc. and plus or minus 5 percent from 30 kc. to 100 kc. Input impedance is 1 megohm plus 15 uuf. shunt capacity. The voltage ranges are indicated on a logarithmic meter with 20 decibels linear spread. Switch positions are provided every 10 decibels. It is self contained in all a-c operated unit. The accuracy is independent of tubes and line voltage within less than plus or minus ½ percent. The instrument serves simultaneously as a voltmeter and high gain amplifier. The amplifier gain is 40,000. Instrument Electronics, 42-17 Douglaston Pkwy., Douglaston, N. Y.



INSTRUMENT ELECTRONICS VOLTMETER

Power Plant

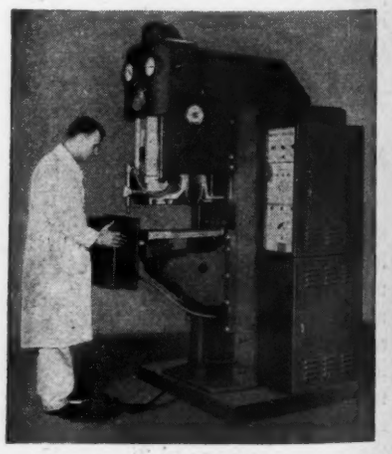
This new Voltbox a-c powersupply offers a portable source of metered, continuously adjustable a-c voltage and current. Three ranges of output voltages and two ranges of output current are available. The variable voltage and current feature is achieved by two powerstat variable transformers operating in conjunction with auxiliary transformers. Voltage and current are varied independently and are electrically isolated from each other. For metering purposes, a triple range voltmeter and a double range ammeter are supplied. The circuit has been designed to permit its use on either 115 or 230 volt 50/60 cycle power lines. The output voltage ranges are 0-30, 0-150, and 0-300 volts while the current ranges are 0-5 and 0-20 amperes. A circuit breaker offers instrument protection. The Superior Electric Company, 220 Church Street, Bristol, Conn.



SUPERIOR VOLTBOX

Resistance Welding Control

A line of synchronous-precision, a-c resistance welding controls in a complete factory assembled pack has been announced. Known as Synchro-Trol, there are eight factory assembled subunits and five supplementary subunits from which it is possible to make hundreds of combinations for timing and sequencing. It may be side-of-welder or floor mounted. It has finger tip control, and a transparent access door. Subunits are of the pull out type and may be removed quickly for changes in control requirements by unloosening two wing nuts and disconnecting the plug connectors. Westinghouse Electric Corporation, Pittsburgh 30, Pa.



WESTINGHOUSE CONTROL

Answered by
F. N. M. SQUIRES and GLENN ROWELL

New York Board of Fire Underwriters
Chief Inspector
New York, N. Y.

Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

Questions on the Code

Thermal Cutouts

Q. *Does the Code require that thermal cutouts for motor running protection be on the motor side of the motor controller?*—M.E.C.

A. No, unless the controller is also the disconnecting switch and the voltage to ground is in excess of 150 volts. Section 2440 covers this and is as follows: "Disconnecting means shall be provided on the supply side of all fuses or thermal cutouts in circuits of more than 150 volts to ground and cartridge fuses in circuits of any voltage, if accessible to other than qualified persons, so that each individual circuit containing fuses or thermal cutouts can be independently disconnected from the source of electrical energy except as provided in Section 2352 and except that a single disconnecting means may be used to control a group of circuits each protected by fuses or thermal cutouts under the conditions described in Section 4410." Section 2352 exempts service fuses and Section 4410 pertains to two or more motors on a single machine or a group of motors in a single room within sight of the disconnecting means.—G.R.

Number of Wires In Conduit?

Q. *Is there any 1947 Code Rule that permits more than four No. 14 Type R wires (within wall insulation) in a ½ inch rigid conduit?*—F.R.B.

A. No. There is one exception, however, given in the note following Table 4 and appearing in the Code just over Table 5 which states that the limitations given in Table 4 do not apply to cases where a short length of conduit is used for mechanical protection over exposed (open work) wiring.—F.N.M.S.

Q. *Are thermoplastic wires (as mentioned in Table 4) and synthetic wires considered the same?* —F.R.B.

A. Yes. Insulation formerly known as synthetic Type SU is now called Thermoplastic Type T.
—F.N.M.S.

Fittings

Q. *I have experienced quite a bit of trouble in getting contractors to use sealing fittings properly in explosive areas such as around gasoline filling stations. These fittings like many other wiring materials are apparently difficult to obtain and as a result they want to use substitutes. Does the Code permit such substitutes and if so, how much sealing compound must be used?*—N.A.R.

A. The answers to your question will be found under Section 5015-C. First, this section states that enclosures for connections or for equipment shall be provided with approved means for sealing or sealing fittings approved for Class 1 locations shall be used. Second, the minimum thickness of the sealing compound shall be not less than the trade size of the conduit and in no case less than ⅝ inch.

This may seem to prohibit the use of substitute fittings as the wording "approved means of sealing" leads one to believe they must use only those fittings or enclosures designed and approved for such use. Under normal conditions of supply this practice should be followed, but the Code does give the authority enforcing the Code the power of determining whether or not a device or fitting shall be considered as approved and this seems an excellent occasion for the application of good judgment in the selection of suitable substitutes. For instance, there seems no good reason why an explosion-proof feed through fitting could not be used provided care was taken to assure proper thickness of the seal. On the other hand the filling of any box without making sure that the sealing compound extends into the raceway a definite distance should not be accepted, nor should we permit the compound to cover splices or taps within the boxes. Possibly by the time this answer is published the present shortage of these devices will be over, at least there are numerous reasons for believing that it will not be long before an electrical inspector need no longer be concerned over substitutes.—G.R.

Auditorium & School Wiring

Q. *Please advise the type of wiring which the Code requires for a church auditorium seating 150 people. Also the type of wiring permitted in school rooms.*—K.C.O.

A. The National Electrical Code does not specify the types of wiring required to be employed in the various types of occupancies but does restrict some of the types of wiring which may be used in certain occupancies.

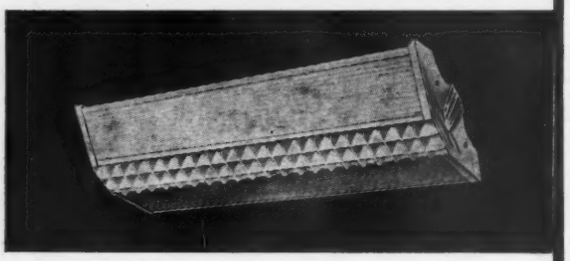
The Code recognizes, Open Wiring on Insulators, Concealed Knob and Tube Work, Armored Cable, Nonmetallic Sheathed Cable, Rigid Metal Conduit, Electric Metallic Tubing, Flexible Metal Conduit and Surface Metal Raceways, all of which may be used for Church Auditoriums and School Rooms and all of which have been so used.

Naturally, some of the above wiring methods are good for those occupancies while others are far from suitable, which of course, is a matter of opinion.

In almost everyone's opinion, open wiring and knob and tube work are

The VANGUARD

Newest SILV-A-KING Fluorescent Fixture . . . for commercial installations



No more dangerous high-ladder gymnastics... no more fancy tools... no more lacerated fingers or strong language! The Vanguard opens as easily, quickly, and safely as your fountain pen—for inspection, cleaning, or re-lamping.

For assurance of minimum maintenance time... Specify the Vanguard!
I. B. E. W., A. F. of L. • Listed by Underwriters' Laboratories, Inc.
Yours for the asking, "Vanguard" Bulletin No. 447FV

SILV-A-KING LIGHTING EQUIPMENT

BRIGHT LIGHT REFLECTOR COMPANY, INC.
Subsidiary of Bridgeport Pressed Steel Corp.
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the least desirable methods, for the classes of work referred to and undoubtedly rigid conduit, the best. Next to rigid conduit, would be electric metallic tubing, then armored cable, flexible metallic conduit, metal surface raceway and non-metallic sheathed cable, in just about the order given. —F.N.M.S.

Service Wires

Q. *Will the Code require service wires larger than No. 10 to supply a small outbuilding containing only a ½ hp. 220 volt motor and four light outlets?*—P.H.H.

A. Section 2304 covers your question and requires that service conductors supplying more than a single circuit be not smaller than No. 8. Inasmuch as you are supplying a 220 volt motor as well as a single lighting circuit, it is obvious that you have more than a single circuit and it therefore is necessary to use the larger conductors.—G.R.

Cartridge Fuses

Q. *Must the cartridge fuses protecting an air conditioning plant in a home be on the equipment side of the disconnecting switch?* —S.M.

A. Fuses accessible to other than qualified persons if of the cartridge type must have a disconnecting means ahead of them regardless of the voltage involved. This requirement will be found under Section 2440. The owner or occupant of a dwelling would, of course, be considered as other than a qualified person, making it necessary to comply with these rules.—G.R.

Wiring A Grain Elevator

Q. *We are planning to wire a grain elevator and someone has told us that we can use thin wall instead of rigid conduit. Does the new code permit this?*—E.R.

A. The Code will permit the use of (thin wall) electrical metal-

Heat foiled again

and again

and again

and again

The switch mechanism in the new Cutler-Hammer line of safety switches is designed to withstand safely any degree of heat that can be expected from correctly selected fuses.

Because of this advantage and because of the greater ease of installation and convenience of operation, because of proved performance and attractive appearance, Cutler-Hammer wholesalers and more and more alert contractors from coast to coast feature and recommend these outstanding switches. ...CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

By the New-

CUTLER-HAMMER
SAFETY SWITCHES
C-H

How

Tulamp Transformers cut installation costs

OF MERCURY LIGHTING

Mercury-vapor lighting, with its high efficiency, is the most economical means of obtaining high levels of illumination in many industrial plants. G-E Tulamp transformers provide the most economical method of installing such lighting.

General Electric Tulamp transformers include units especially designed for the popular H-1, 400-watt lamp. All Tulamp transformers combine the ballast of two lamps into one compact unit, reducing by one-half the number of transformers required. Installation is further simplified by carrying a common ground to the lamps. Power factor is 90 to 95 per cent, transformer losses are reduced, and starting current is less —all of which permits further reduction in wiring costs. Single units cost less than pairs of single-lamp high-power-factor transformers.

Built by the largest manufacturer of Mercury H lamps, Tulamp transformers assure you co-ordinated design of lamp and transformer. They are quiet, eliminate stroboscopic effect, will give years of dependable operation.

SHORT DELIVERY *G-E mercury-vapor-lamp transformers are available on short delivery. Write for full information on General Electric's complete line of transformers for mercury lighting. Address the nearest G-E office, or Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

413-25

lic tubing in those areas of a grain elevator where dust does not accumulate on horizontal surfaces, but in all rooms or areas where dust may be in suspension or is likely to be during normal operation of the elevator the Code requires the use of rigid conduit. There are few areas in the average grain elevator where deposits of dust cannot be found on horizontal surfaces. In fact, in the average country elevator the office and the feed warehouse are usually the only possible areas where electrical metallic tubing might be used.

This misunderstanding has no doubt been caused by the fact that the 1947 Code divides each hazardous area into either Division 1 or 2, and under Division 2 permission is given to use tubing. However, if you will refer to Section 5005 you will note that a Division 2 location is one containing only dust-tight machinery, spouting, conveyors or bins from which dust can be released only by actual breakdown or rupture of the dust-tight enclosures. —G.R.

20 Ampere Fuse on Lighting Circuit

Q. *Was it the intent of the Article Committee in Section 2123C2 to allow 20 amp. fusing of lighting fixtures in residential occupancies?*—H.C.A.

A. Where a branch lighting circuit has connected to it only heavy duty lampholders or lampholders for fluorescent lamps and no receptacle outlets connected to it, it may be a 20 amp. circuit, wired with No. 12 wire and fused at 20 amperes. The fixture tap, including ballast wires, must not be smaller than No. 14.

The Code permits such a 20 amp. circuit as above and also the "12 wire circuit for appliances in the kitchen, diningroom, pantry and laundry" to be fused at 20 amp. in dwelling occupancies.—F.N.M.S.

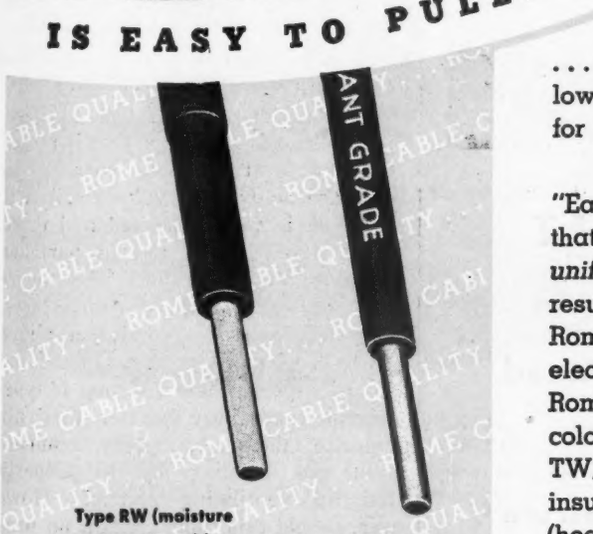
Junction Boxes

Q. *We have recently had occasion to question the ruling of our inspector who has refused to let us carry the feeder, supplying several small motors, through the switch boxes supplying each individual motor. This has been a quite common practice around here and we have never before*

Rome Building Wire

... because unusual care is taken to provide well-centered insulation. Smaller diameter makes handling of multiple circuits easier ... facilitates pulling through conduit runs ... means more room in junction boxes.

... because the insulation, both rubber and thermoplastic, is especially compounded so that it comes off easily, leaving the copper conductor clean ... for easy and positive connection. All Rome compounds are constantly checked for electrical and physical characteristics in a special control laboratory.



Type RW (moisture resistant), rubber insulated.

Type TW (moisture resistant), Rome Synthinol thermoplastic insulated.

... because the finish is carefully treated to give you a smooth, low-friction surface and, consequently, easier pulling. Check for yourself the smooth waxed surface of Rome building wire.

"Easy to work" is the electrician's expression for a building wire that handles well, pulls easily, strips cleanly, and is known for *uniformly high quality*. He likes it because it saves him time with resultant reduction of installation costs. That is one reason why Rome Cable Building Wires have found wide recognition among electrical wholesalers and contractors ... they are easy to work. Rome Building Wires are available in all standard sizes and colors of Rome Synthinol* Thermoplastic Insulated Types T and TW, for general purpose and wet location use, as well as, rubber insulated types R (general purpose), RW (moisture resistant), RH (heat resistant), and RL (rubber and lead).

Don't risk buying, or specifying, Building Wire by type alone. Make sure it is surface printed "ROME CABLE."

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CORPORATION
ROME • NEW YORK

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BRASS RING!

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***Improves* When You**

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Monarch *Renewable* Fuses

BUILT WITH AN ADEQUATE AMOUNT OF

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MONARCH FUSE CO., LTD.

118 E. FIRST ST. JAMESTOWN, N. Y.

been questioned about it. Is this a personal idea or does the Code now require a special junction box ahead of such a switch permitting only the top to be brought into each switch cabinet? —L.H.W.

A. Unless the disconnecting switch or controller cabinets are designed with special wireways they are not to be used for junction boxes. Section 4307 reads as follows: "Enclosures for controllers and disconnecting means for motors shall not be used as junction boxes, troughs or raceways for conductors feeding through or tapping off to other apparatus unless designs are employed which provide adequate space for this purpose." This is a new provision of the Code found for the first time in the 1947 edition and made necessary by the quite common practice of crowding of the wireways within these enclosures.—G.R.

Explosion Proof Equipment

Q. *We are wiring a small manufacturing plant which will use two paint dip tanks in an open room approximately 40 by 60 feet. Must this room be wired only with explosion-proof equipment?*—A.P.R.

A. This is a question that is rather difficult to answer correctly as there are many facts unknown, but if the room is well ventilated and there is no possibility of molten particles dropping into the dip tanks from overhead motors, cabinets or fixtures, equipment located several feet above the level of tanks need not be of the explosion-proof Class 1 Group D type. Solvent vapors are heavier than air and are, therefore, readily removed from the building by a properly designed ventilating system. However, should this room contain no provisions for the removal of this vapor, it should be wired with the explosion-proof equipment.—G.R.

Cove Lighting

Q. *I am installing cove lighting in the living rooms of several homes in our city. This will consist of tubular lighting operating at 1,000 volts as permitted by the Code. These buildings are one story with attic space*

"Certified" ON A BALLAST...
IS MORE THAN A WORD!
. . . Measuring Certified Ballast temperatures while ballast is operating in an actual fluorescent fixture.
Hot Box! Certified Ballasts are tested and checked against overheating. Test oven determines temperature rise.
Certified Ballasts are checked and rechecked in actual service—an additional safeguard for high quality.

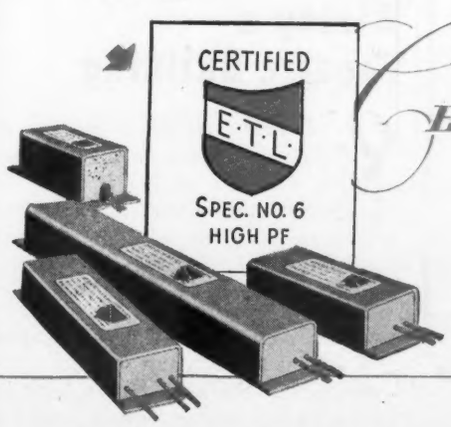
When fluorescent lighting fixtures are equipped with Certified Ballasts, you and your customers are protected

CERTIFIED FLEUR-O-LIER MANUFACTURERS, RLM STANDARDS INSTITUTE and CERTIFIED LAMP MAKERS have solved their ballast problems by writing CERTIFIED BALLASTS into their specifications.

YES, "CERTIFIED" on a ballast means that this ballast has been built to exacting specifications set up by lighting experts . . . that it has been *tested, checked* and *CERTIFIED* by impartial Electrical Testing Laboratories, Inc.

"Certified" further means ballasts that are *quiet* in operation . . . protected against overheating . . . and long lived. And they cost no more than any other ballasts!

Write today for new booklet, "The Story of Certified Ballasts."



CERTIFIED BALLAST MANUFACTURERS

Makers of Certified Ballasts for Fluorescent Lighting Fixtures

Acme Electric Corporation
Cuba, New York

Advance Transformer Company
1122 West Catalpa Avenue
Chicago 40, Illinois

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over the living rooms varying from nothing at the exterior walls to about 4 feet at the highest part of the roof. This space is accessible through a scuttle hole in a closet, and I wish to mount the ballast units in this attic. Will the Code permit this?—J.M.K.

A. Yes, the Code will permit the installation of the transformers in any accessible space and the Code defines an accessible space as one which may be reached without removing any of the building structure or finish. However, the Code is a set of minimum standards and compliance with these standards does not assure convenient nor efficient installations. Therefore equipment such as these transformers should, if possible, be located where they can be readily reached for proper maintenance. It is common practice to locate such units within a metal cabinet accessible from a removable panel set flush with the wall above the cove.—G.R.

Bus Duct Installation

Q. *When installing bus duct to supply motor driven tools on a production line, does the Code provide a definite limit to the maximum length of the duct that may be used?* —D.G.

A. The N. E. Code contains a recommendation that the length of a bus duct used as a branch circuit be limited in length to three times the ampere rating of the overcurrent protective device used on the circuit. Therefore, if such protection was rated at 50 amperes the bus duct should not exceed 150 feet in length. This is a recommendation and not a requirement. however, due to loading on such a duct, it might be impractical to use one that long.—G.R.

Wiring a Theatre Building

Q. *I have just taken the job of wiring a small theatre building and the question of control for the emergency lighting circuit is holding up the permit as the plans do not call for an automatic switch for this circuit. Is this required by the Code?*—S.A.

A. The automatically operated emergency control is an alternate requirement only. It need not be used if both the emergency and the

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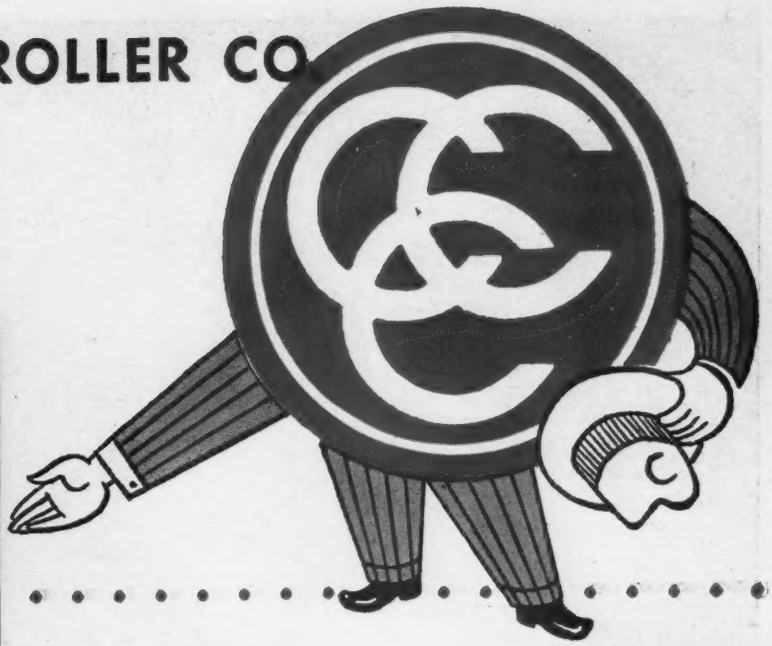

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regular lighting systems are kept on during the time the general public have access to the theatre. If you will refer to Section 7021 of the Code you will find the following: "Lights shall be provided and so located and supplied as to provide with one service interrupted, emergency illumination without appreciable delay. The installation of lights would ordinarily require either one of the following:

(a) An emergency lighting system independent of the general lighting system with provisions for automatically transferring by means approved for the purpose, the emergency system from a defective supply to another supply.

(b) Two or more separate and complete systems with independent current supply each providing emergency lighting. Unless both systems are kept lighted, means shall be provided for automatically lighting either system upon failure of the other. Either or both may be a part of the general house lighting system if circuits carrying lights for emergency illumination are installed in accordance with other sections of this Code."—G.R.

Wiring a Creamery

Q. *We started to wire a creamery and the inspector has demanded that we provide a half inch clearance between the conduits and the walls in the churn room as he claims this is now required by the Code. Does this mean that outlet boxes and other conduit fittings must also be one-half inch out from the wall and ceiling?*—W.E.

A. No, outlet boxes, junction boxes and other conduit fittings need not be spaced one-half inch from the surface of the wall or ceiling. They must, however, be of the weatherproof type. These rules may be found under Section 3705 of the Code.

This brings up the problem of how to fasten the ordinary weatherproof box, as a conduit run spaced one-half inch from a wall unless offset will hold the box out from the wall approximately one-fourth inch. Section 3707 states that boxes, fittings or cabinets attached to conduits by threading which are not over 100 cubic inches in size need not be separately attached to the building surface. Therefore the average outlet box in this churn room can be supported by the conduit runs. Distribution cabinets and cutout boxes if of the surface type must also have one-half inch separation from the wall on which they are mounted.—G.R.

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Industrial Electrification

ENGINEERING • INSTALLATION • MAINTENANCE

Electrical Indicating Instruments—Part II

By Lawrence F. Parachini
Educational Engineer
Weston Electrical Instrument Corp.
Newark, New Jersey

AS indicated in the previous article of this series (E. C. and M., Aug. 1947) the subject of indicating instruments is one of very broad scope. Broad in scope for two reasons; one, because of the great number of instrument possibilities which should be discussed and, two, because of the tremendous diversification of responsibility now placed on the maintenance engineer and his men. Incidentally, these responsibilities are, as a rule, imposed almost as a double burden because in most cases the maintenance department is considered a pure spending function. The budget allotted very likely is proportional to the overall efficient operation of the plant and the savings shown by the maintenance group.

Electrical instruments fit into this picture because of the obvious functions they perform in indicating existing conditions of electrical circuits and apparatus and thus providing information for correcting defects. From the standpoint of preventive maintenance careful accurate data can be kept and maximum life obtained from equipment. Such factors as proper depreciation can be established from logged data.

In the first article a brief discussion of some basic electrical instrument types was given together with data to aid in their selection, use and care. It is proposed herein to elaborate on the subject by covering special types not discussed and by outlining some of the more common tests performed by the maintenance man.

RECTIFIERS and THERMOELEMENTS

To the maintenance man these instrument accessories are gadgets born of the era of electronics. The widespread use of industrial electronic devices for both measurement and control of industrial processes require instrumentation in the realm of high frequency a-c at both low current and voltage. Rectifiers and thermoelements, added to basic permanent magnet moving coil mechanisms and often incorporated into built up test equipment, form the basis of most of the electronic circuit test instruments.

It is interesting to note that this represents a new field for the maintenance man. Measurements of this nature were previously confined to the communication industry.

Rectifiers

The construction of a typical instrument rectifier disc of the copper oxide type is shown in Fig. 1. It has the unique property of being virtually unidirectional as to current flow. In other words, with an a-c voltage applied across the disc, current will flow readily in the direction, oxide to copper, but relatively no current will flow in the reverse direction. Because this unit requires relatively little energy to operate it is ideal for use with a d-c mechanism for a-c current and voltage measurements.

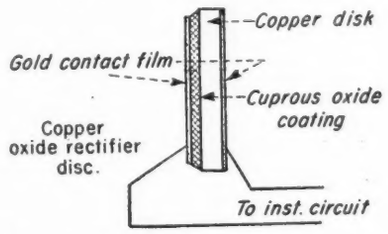


FIG. 1. Typical instrument rectifier disc of the copper oxide type is virtually unidirectional as to current flow.

While several materials have been used and considered, the most common and satisfactory is the copper oxide combination shown. As a rule, four discs arranged in bridge fashion as illustrated by Fig. 2, (a) for current measurement; (b) for voltage measurement and (c) for voltage measurement at constant impedance, is standard. The four disc bridge circuit achieves greater efficiency by virtue of full wave rectification and in addition, because it is conducting on both halves of the cycle, high back voltage never occurs.

The copper oxide rectifier is a very important accessory and finds its greatest use in electronic measurements where high a-c sensitivity is necessary. While not as accurate as conventional moving iron vane or electrodynamometer types of instruments, sensitivity of the order of 50 ma. full scale is common which is far beyond the scope both of the other types. As voltmeters, again the high sensitivity is advantageous in producing high impedance types usable on low energy circuits with a minimum of circuit disturbance. Frequency coverage is of the order of 25 to 20,000 cycles which is also beyond the scope of the other two instrument types mentioned.

Rectifier types of instruments, unfortunately, are not without undesirable characteristics. The most

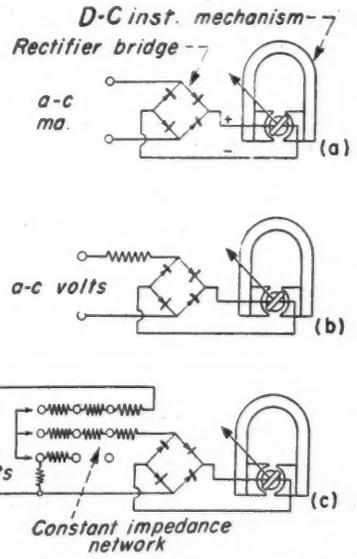


FIG. 2. Standard arrangements of four discs in bridge fashion measure current (a), voltage (b) and voltage at constant impedance (c).

serious of these being the effects of temperature and wave shape. The first is due to several changes at different rates, changes of forward and reversed resistance as well as rectification efficiency variation with temperatures. Wave shape errors are due to the fact that the scale is calibrated in terms of rms. values while the instrument actually indicates average value. On a sine wave calibrating source, this r.m.s. to average ratio is calibrated in. Actually it means the instrument is calibrated to read 111 percent of the average since the rms. to average ratio is 1.11. When a rectifier instrument is used on d-c for example it reads 11 percent high and readings on a-c will vary with variations in wave shape; or to state it differently, indications vary with form factor.

The proper use of instruments by the maintenance man automatically impresses the burden of recognizing and understanding the various errors or limitations of each instrument. Thus he is able to correctly use the data obtained.

Fortunately, as far as the use of rectifier instruments is concerned, the errors cited can usually be neglected because of the nature of measurements made with this type. A-c currents and voltages of electronic equipment are very rarely critical and accuracies of 5 percent suffice. Where this does not hold it is very often possible to use standard moving iron or electrodynamometer types of instruments with inherently greater accuracy but with less sensitivity.

Thermoelements

Thermal elements make possible the use of sensitive low energy d-c mechanisms for the measurement of the effective (rms.) a-c current of frequencies up to 100 megacycles at good accuracy. Thermoammeters are usable as standards for rectifier types and may be applied in place of them where circuit conditions require high accuracy. They have low overload capacity however and may be burned out readily. Sensitivity down to 1 ma. only is possible.

Instruments containing thermoelements are relatively unfamiliar to the maintenance man but will likely become more common as high frequency heating and processing and communication comes into use. On this basis he should familiarize himself with their construction and operation.

Three general types are used:

a. Vacuum type. Fig. 3. Heater wire and thermocouple contained in highly evacuated glass bulb. For low current ranges to about 1 milliampere rating.

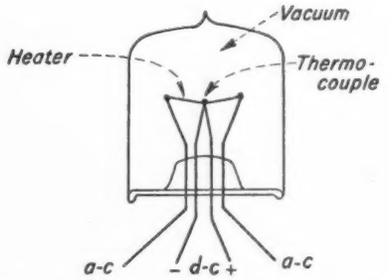


FIG. 3. Vacuum type of thermoelement instrument contains heater wire and thermocouple in highly evacuated glass bulb.

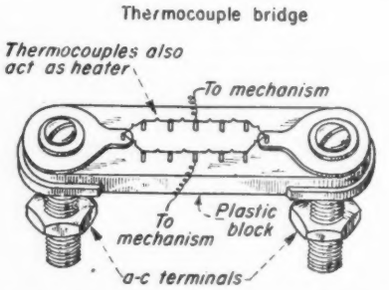


FIG 4. Bridge type of thermoelement instrument has an arrangement of thermocouples disposed in bridge fashion on a plastic plate.

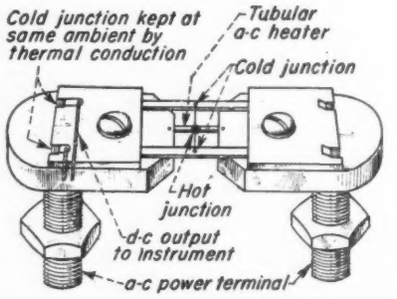


FIG. 5. Compensated thermoelement instrument contains a heater and contact thermocouple arrangement for high currents above .5 amps.

b. Bridge or mutual couple type. Fig. 4. An arrangement of thermocouples disposed in bridge fashion on a plastic plate. The thermocouples serve also as the heater. A very efficient arrangement for ranges from about 100 milliamperes to 750 milliamperes.

c. Compensated. Fig. 5. A heater and contact thermocouple arrangement for high currents above ½ ampere. Provided with cold end compensation for ambient temperature changes.

Very simply, the operation of these units can be said to be similar and dependent upon the heating effect of the current to be measured. This current is conducted through the heater of the element and the resultant heat measured by the thermocouple. In the use of thermoelements the heat is translated to amperes on the scale through the voltage developed by the couple in terms of the current squared.

THERMOCOUPLES and RESISTANCE THERMOMETERS

The ability to make accurate measurements of temperature by the use of two pieces of wire and a sensitive d-c instrument has proved a great boon to industry. Modern pyrometry attests this fact as does the array of instruments and control devices used in such industries as the steel, chemical, oil and food.

The use of these two wires by the maintenance man should not be depreciated. They offer him a versatile tool. He should always be concerned with such facts as temperature of rotating equipment bearings and windings from the standpoint of maintenance prevention, and the use of thermocouples is suggested.

Without attempting to cover the subject completely, a task far beyond the scope of this article, it might be well to note some facts.

Two dissimilar metals (note table below) joined at one end constitute a thermocouple. If the temperature of this junction is altered, in relation to that of the other ends, a voltage is developed which may be measured by an instrument connected to the open ends; refer to Fig. 6. The magnitude of the voltage is a function of the materials used and the difference in temperature between the hot and cold end. No other source of energy is necessary for operation.

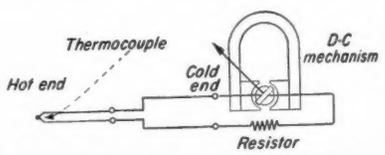


FIG. 6. When temperature of thermocouple junction is altered in relation to opposite end, voltage is developed which may be measured by instrument connected to open end.

Most thermocouples are suitable for high temperatures. Their voltage generation is such that they are not practical below about 200 degrees F. temperature difference. The following thermocouples are commonly used, the voltage generated is given on the basis of 0-100 degrees F. (it varies slightly with temperature).

Material	*Range in degs. F.*	*Microvolts per deg. F.*
Iron vs. Constantan	0 to 2000	28.8
Copper vs. Constantan	0 to 600	23.0
Chromel vs. Alumel	0 to 2500	22.0
Platinum vs. Plat. + 10% Iridium	0 to 3100	3.1

This over-simplification of the subject should not mislead one into considering the subject of thermocouple measurements lightly. It is fraught with many pitfalls because of the small energy involved. However, because of much literature on the subject no expansion was considered here. It might be said that this discussion should serve as a short note on the subject.

The change in resistance of a conductor, such as copper for example, with changes in temperature can be used as the means of measuring temperature in the low range not practical with the thermocouple. This is called the resistance thermometer method and is also well known. A temperature sensitive element of copper, nickel, platinum or combinations of these materials is located at the point to be measured. Often these elements are embedded in equipment such as motors and generators as a convenience. The element is connected as shown by Fig. 7. Note that an external source of power is necessary. In other words, this resistance thermometer is our familiar Wheatstone bridge with the variable arm controlled by temperature changes. A sensitive d-c instrument is used and calibrated in degrees. Of course the precautions of Wheatstone bridge use apply.

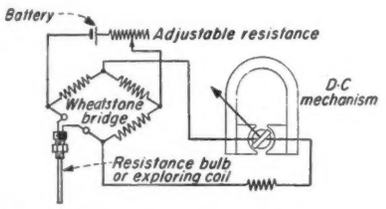


FIG. 7. Resistance thermometer method of indicating temperatures can be used in a low range not practical for thermocouple application.

It is strongly recommended that more study of these temperature measurement procedures be undertaken. They offer some very concrete advantages of accessibility and flexibility that they constitute a very versatile tool.

MAGNETOS (TACHOMETER GENERATORS)

A generator, either a-c or d-c so constructed that the voltage generated is truly proportional to speed is a magneto. The output of the generator is applied either to a d-c instrument arranged as a voltmeter or a rectifier type of instrument for a-c magneto output. (Fig. 8). The instrument, while operating on voltage directly, is calibrated in rpm. or other speed factors such as miles per hour.

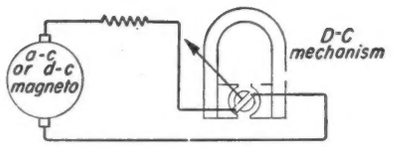


FIG. 8. Output is applied to either a d-c instrument arranged as a voltmeter or to a rectifier type of instrument for a-c magneto output.

Basically, the only problem of use is one of installation of the magneto and its maintenance. As for other rotary equipment the maximum safe speed should not be exceeded and periodic commutator and brush cleaning should be established (for d-c type).

In either type of magneto a permanent magnet is used to provide the field flux. An output of 6 to 10 volts generated per 1000 rpm. is common while the resistance of the windings varies from 20 to 200 ohms depending on type.

PHOTRONIC CELLS

The photronic photoelectric cell may be considered as a converter of energy, light energy to electrical. It is a self generating solid or so-called barrier layer type of cell. The current output is a function of the illumination on the cell surface and the resistance of the external instrument circuit. The ideal output relation exists with zero external resistance.

The photronic cell without any other source of energy and without amplifiers can be made to operate d-c instrument mechanisms. (Fig. 9). Its construction is simplicity itself; an iron disc on which is formed a selenium oxide coating which is in turn covered with a transparent metallic coating.

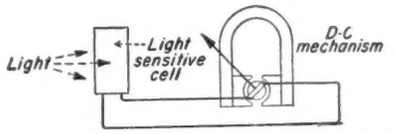


FIG. 9. The photronic photoelectric cell converts light energy to electrical energy and can be made to operate d-c instrument mechanisms.

The response to various wave lengths of the color spectrum differs from that of the eye and must be corrected by the use of a viscor filter in applications involving slight measurements for sight. No corrections are necessary for the various types of light sources.

The photronic cell in conjunction with either instruments or relays and control devices, forms the basis for many specialized maintenance tasks. To name just a few:

Illumination, measurements and the study of correct lighting at the machine.

Illumination control for the shop.

Counting operations.

Operations of safety devices.

Conveyor belt control.

Smoke alarms.

APPLICATION

Having reviewed the various electrical indicating instruments and associated accessories available to the maintenance man, it is perhaps time to associate them with his daily tasks.

There are probably as many views of the maintenance or electrical departments' responsibilities as there are departments but it would seem that they have in common a job which might be summarized as follows:

1. Maintaining plant operation.
2. Determining inefficiency of plant equipment and making proper corrections.
3. Increasing the efficiency of plant apparatus, individually and overall.
4. By preventive maintenance, reducing emergency repairs to equipment to a minimum.
5. Insuring a maximum retardation of equipment depreciation.
6. Determine the necessity of additional plant equipment.
7. Maintain plant equipment in safe operating condition to the satisfaction of plant personnel.

This last requirement may seem a little far fetched but a review of recent work stoppages will indicate that the matter of satisfying the machine operator is very important.

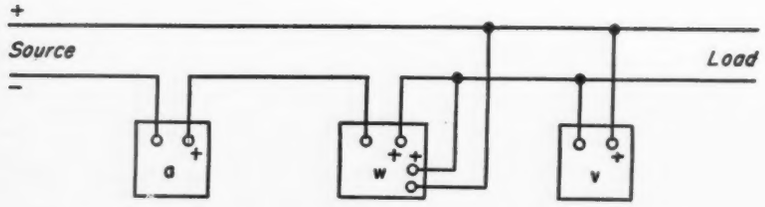
To each maintenance group these responsibilities may carry different evaluations and therefore, different procedures. In general, however, it can be said without reservation that the use of electrical instruments can greatly simplify and facilitate their fulfillment.

Some of the following testing procedures in which instruments must be used will illustrate their need. These tests are all necessary if the above requirements are to be met.

1. The determination of motor loading from the standpoint of efficiency of operation.

This is a very necessary job because of the extensive power waste possible by improper use of motor capacity. In all plants it should be the job of the maintenance group to properly distribute the load so as to minimize loss. In this one procedure it is often possible to justify expense of all the instrument equipment necessary for the department.

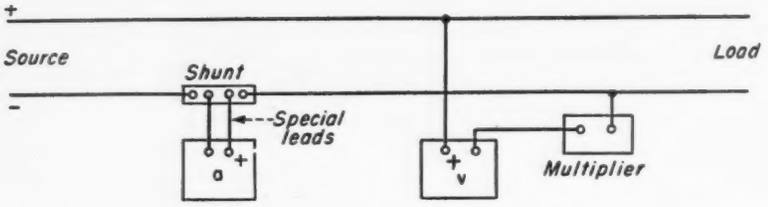
Let us examine an example involving a 25 and 50 hp. induction motor.



Note: *Wattmeter may be omitted and product of volts and amperes used*

a = *Ammeter*
w = *Wattmeter*
v = *Voltmeter*

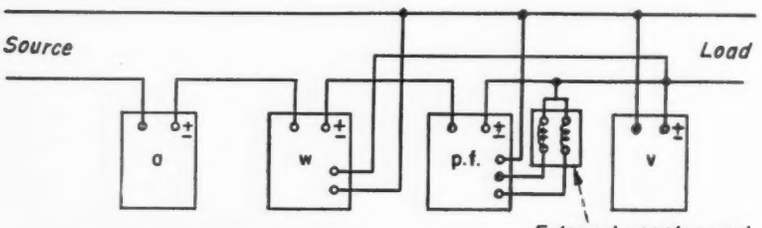
D-c testing with self contained instruments employs the use of an ammeter, wattmeter and voltmeter.



Note: *Wattmeter is omitted. Special instrument would be required. Use product of a and v*

a = *Ammeter*
v = *Voltmeter*

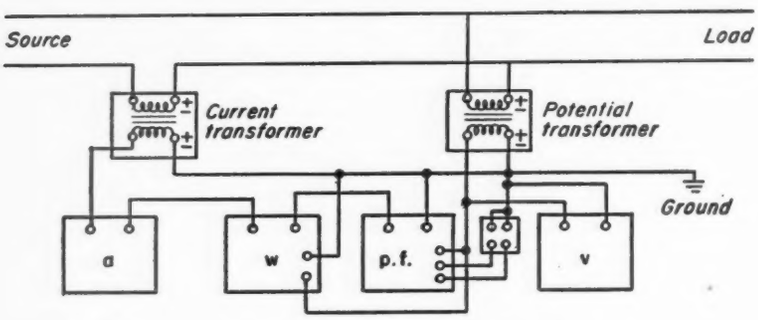
D-c testing with external shunts and multipliers is accomplished by connecting instruments as shown above.



Note: *Power factor meter may be omitted and power factor determined from watts and volt amperes*

a = Ammeter
w = Wattmeter
p.f. = Power factor meter
v = Voltmeter

Single phase a-c testing with self contained instruments employs an ammeter, wattmeter, voltmeter and power factor meter.



a = Ammeter
w = Wattmeter
p.f. = Power factor meter
v = Voltmeter

Single phase a-c testing can be accomplished by inserting current and potential transformers.

If a 50 hp. motor is used to drive a 25 hp. load it will waste almost 1 kw. of power because of the poor efficiency of the large machine at low loads.

Efficiency of 50 hp. motor at half load is approximately 84 percent, a 25 hp. motor is 89 percent efficient at full load thus a difference of approximately .9 kilowatts exists. This example does not take into account such other factors as power factor and light load operation that would further indicate the folly of operating a motor at half load.

Since the electric motor is one of the largest consumers of power in the industrial plant it should be given careful consideration in any test schedule. An efficient maintenance group should have a complete survey of its motor loading and proper allocations made.

Aside from proper driving allocation, it is important to periodically check the loading on motors to detect any deterioration of equipment and of load. It is often possible to anticipate trouble on a machine by watching the power necessary to drive it.

Instrumentation for this phase of the maintenance man's work consists of the standard ammeters, voltmeters and wattmeters or a combination device such as an industrial analyzer which combines a polyphase wattmeter, power factor meter and an ammeter and voltmeter. Ranges and accuracy will depend on the job.

It might be of interest to note that once having established the proper motor allocations on the basis of power, that current measurements can be made as an indication of operating conditions. As a matter of fact this need is being recognized by the installation on many large machine tools of motor ammeters to be watched for overload conditions and as a means of setting proper operating conditions. The installation of ammeters on equipment may be highly desirable.

2. The determination of current in conductors to insure against overloading and thus excessive drop and to maintain safe operating conditions from the standpoint of temperature.

Aside from the possible fire hazard existing under conditions of overloaded conductors, there are the factors of rapid deterioration of insulation, excessive voltage drop and poor regulation, and power loss to be reckoned with. All cost money and provoke shutdowns. A periodic check of the current in the lines and busses throughout the plant will safeguard against difficulty; further, it will indicate need for new installation and thus maintain high efficiency.

It might be of interest to examine an example. Consider a circuit consisting of a pair of No. 0 wires 1000 ft. long and carrying 150 amperes.

The total resistance of the circuit is of the order of 0.2 ohms and thus the power loss (I^2R) equals 150^2 x 0.2 equals 4.5 kilowatts. The yearly cost on a basis of .01 a kwh. and a 40 hour week is of the order of $93.60. Moreover, the voltage drop is 150 x .2 or 30 volts which in a standard 230 volt system is excessive. Poor voltage regulation exists and thus poor equipment efficiency.

For Any Atmosphere—

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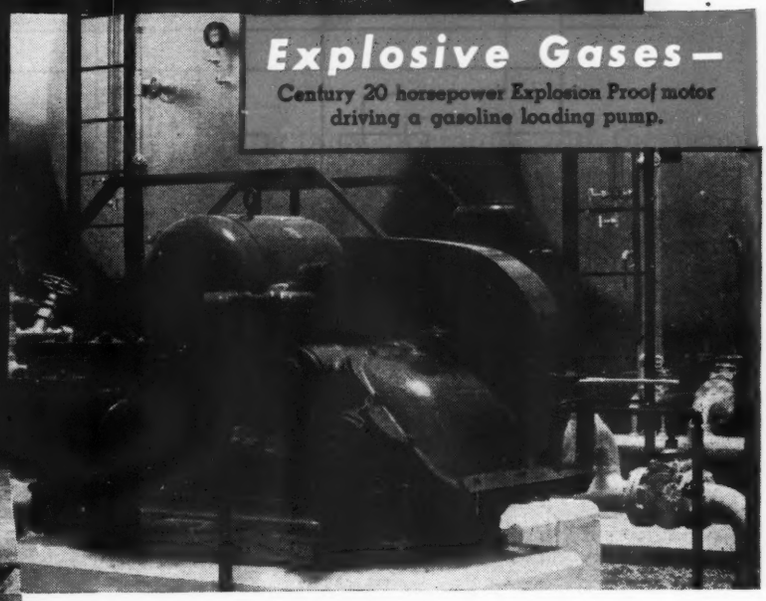

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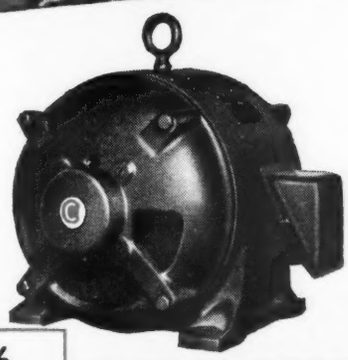

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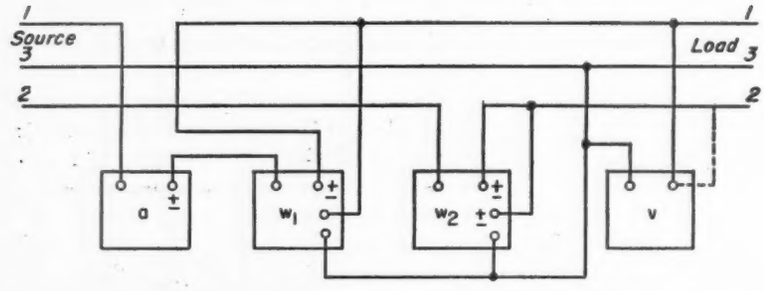


Note: *Two wattmeters (w_1 and w_2) are shown which can be replaced by a polyphase wattmeter - Power factor meter does not show connections illustrated under transformer type of circuit*

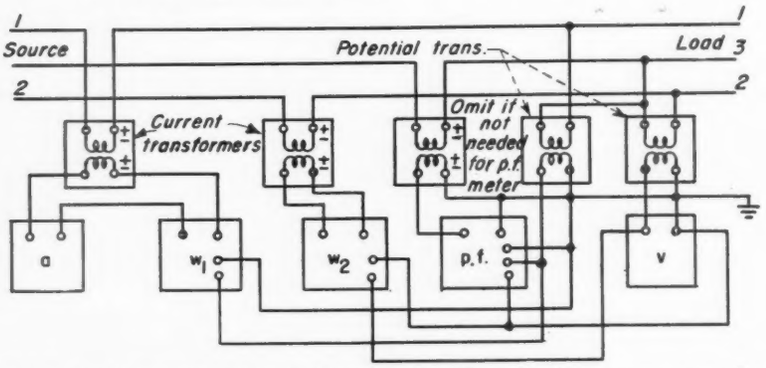
Voltmeter (v) - must be switched to all lines for 3Ø voltage measurements.

Ammeter (a) - only one is necessary if lines are balanced

A-c polyphase testing for either 2 or 3-phase 3-wire systems can be accomplished by using self contained instruments.

Voltmeter (v) - must be switched to all lines for 3Ø voltage measurements

Ammeter (a) - only one is necessary if lines are balanced



A-c polyphase testing for 2-phase and 3-phase 3-wire systems can be accomplished with current and potential transformers.

Obviously the current in the circuit is too high, besides the conductors are operating too warm. Consideration should be given to providing more conductor in the form of another No. 0 in parallel or replacing by a No. 0000.

The No. 0000 would have half the resistance and thus cut the power loss in half, the heating and the voltage drop. Half of the above $93.60 would be saved but more important the regulation of equipment, its efficiency would be improved.

Periodic checks of circuit current should be made of all important feeders and lines and a log of data kept. Accurate ammeters may be used although the clamp type provides sufficient accuracy for this purpose. The clamp ammeter is indispensable since it provides measurements of line current without cutting into the circuit physically. Ranges up to 2000 amperes are available.

3. The determination of line voltage applied to motors, lights and other electrical equipment.

Operating voltage is a very critical factor on most electrical equipment. Light output and life are widely affected as well as efficiency of electromagnetic equipment. Control circuits are often made sensitive to voltage and therefore must be maintained at the correct value.

The exceptions as indicated above are usually the measurement of electronic equipment voltages. These tests however are normally made only on trouble shooting calls and not as a matter of maintenance routine. In many of these instances, such instruments as vacuum tube voltmeters are necessary to provide sufficiently high impedance.

4. To determine insulation resistance and prevent grounding and voltage breakdown.

These tests too should be made periodically as a preventive measure. Voltage breakdown and deterioration of insulation can become very disturbing factors both from the standpoint of equipment failure and from the personnel safety aspect.

These tests are usually conducted with a "Megger" which applies 500 or 1000 volts to the apparatus under test while measuring insulation resistance. This is a combination dielectric and resistance test. Where it is felt that high voltage for breakdown purposes is unnecessary, smaller self operating megohmmeters can be used to advantage. These are available in ranges up to 10 billion ohms.

5. To determine illumination level.

This may come as a new task to the maintenance man but it is being included because of its overall effect on plant operation and efficiency. In addition, there are now available convenient portable instruments to measure the footcandle illumination at any point of use.

There is little doubt that studies should be made of lighting in the plant since it has a direct bearing on output and cost. In addition, maintenance of good lighting is necessary and can be conducted effectively.

In addition to the major tasks outlined above the maintenance man should include the following:

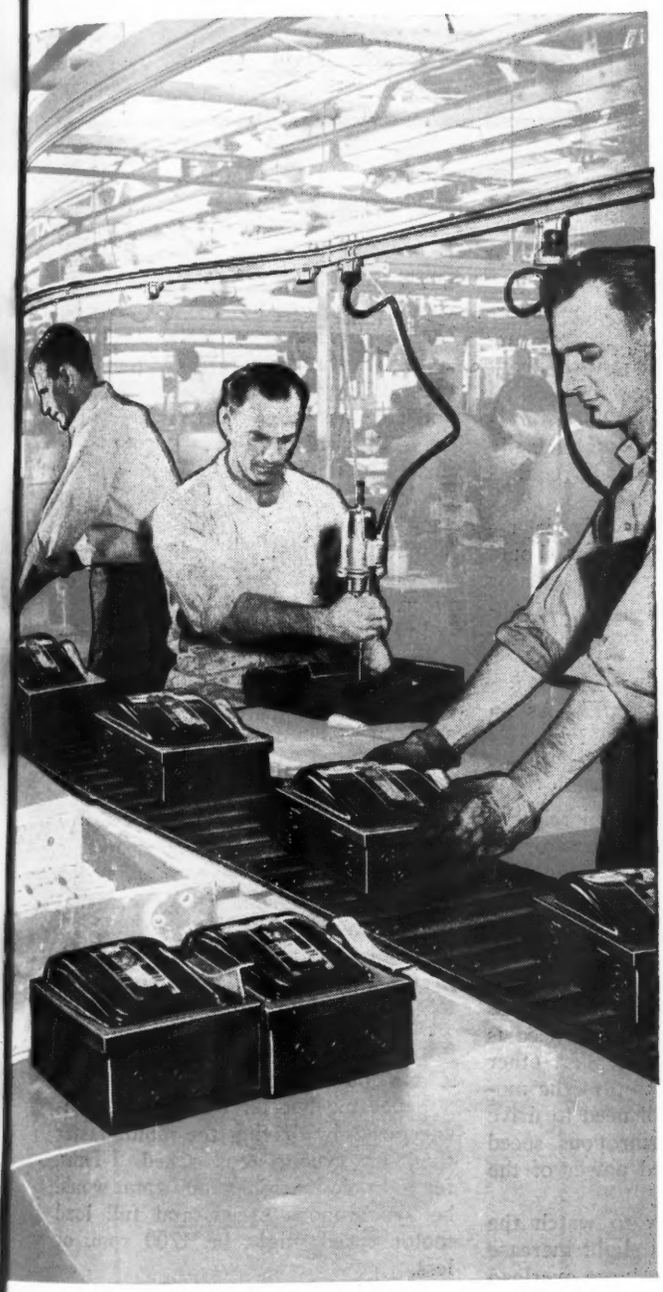
1. The measurement of speed of rotating and conveyor equipment.
2. The measurement of temperature of bearings, windings of motors, generators and transformers, and of ovens.
3. The measurement of circuit constants and components such as vacuum tubes involved in industrial electronic equipment.
4. The measurement of noise level and vibration of moving equipment.
5. The measurement of overall power, power factor, etc. to determine proper overall distribution.

For all these tests and others which may have been overlooked in the discussion, there exists a proper instrument as a tool of the maintenance man.

By way of conclusion it may be said that the present day maintenance man should have at his disposal a rather complete set of the basic tools discussed in these papers. As the scope of manufacturing is widened and the processes become more varied and complex, the range of electrical measurements to be made will multiply and a list of instruments somewhat as follows will be common:

1. Portable high accuracy voltmeters, ammeters and wattmeters (a-c and d-c).
2. Power factor and frequency meters.
3. Power analyzer.
4. Clamp ammeter.
5. A-c, d-c circuit analyzer, high sensitivity type (volts, ohms, ma.).
6. Vacuum tube voltmeter or electronic volt-ohm-milliammeter.
7. Vacuum tube tester.
8. Insulation tester.
9. Footcandle meter.
10. Electric tachometer.
11. Temperature measuring equipment, thermocouple and resistance thermometer type.

switches, anyhow?



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Reader's Quiz

Booster Generator

QUESTION 255—Is it possible to convert a 70 kw., 2300 volt, 3 phase squirrel cage motor into a generator, and use for a booster on a 2300 volt line which is energized?—W.H.L.

A. TO QUESTION 255—The 70 kw. 2300 volt 3 phase squirrel cage induction motor in question can be used as a booster generator by connecting the stator winding to the three phase line and driving it at a speed above synchronous speed in the same direction of rotation that it ran in as a motor. It must, of course, be operated in parallel with a synchronous generator which will govern the frequency, as well as the voltage.

When operated as described the motor becomes an induction generator. Since it has no exciting current this must be supplied by the synchronous alternator, which must also supply reactive currents to the load. The exciting current will vary from about 12% of full load rating when operating at no load, but will run 25% or higher under load. The exciting current may be kept low by keeping the air gap low.

The power supplied by the induction alternator will be proportional to the increase in speed above synchronous speed.—C.E.B.

A. TO QUESTION 255—The term "10 kw." is misleading. I am wondering if W.H.L. could mean a synchronous motor. This type of motor is often rated in kilowatts at a specified power factor, 70 kw. 0.80 p.f., etc. Since synchronous motors are simply alternators used as motors, they can be and often are connected in parallel with synchronous alternators and used as boosters, or synchronous condensers for power factor correction.

Assuming a typographical error, a 70 hp. squirrel-cage induction motor can be used as an induction generator. The revolving field is supplied from the a-c system and the rotor driven above synchronous speed from an external source, and in the same direction as the rotating field.

The power delivered will depend upon the slip, (motor action) and will be approximately the same as would be delivered at full load when operating as a motor. In other words, the full load speed of a 6-pole squirrel-cage induction motor may be 1150 rpm., operating as an induction generator the machine would be fully loaded at about 1250 rpm.

Whether or not either type of machine could be operated satisfactorily would depend upon the system requirements.

If voltage regulation only is required, the induction regulator should be considered. This type of regulator can be manually operated, or made automatic by means of a voltage relay and small motor.—T.B.B.

A. TO QUESTION 255—As an induction generator is merely an induction motor driven at a speed higher than synchronous speed, therefore, W.H.L. can use his squirrel cage motor as an induction generator as long as he operates it in parallel with a system supplied by a synchronous generator which he has in the line he wants to tie to.

He will need to drive the motor at the same percent over synchronous speed as the full load slip or speed is under synchronous speed. In other words, if the pull load slip of the motor is 5 percent, he will need to drive it 5 percent over synchronous speed to deliver the full rated power of the motor to the system.

It will be necessary to watch the speed very closely as a slight increase in speed will result in a large overload on his generator as the load will vary directly as to the speed over synchronous.

An induction generator always operates with a leading power factor the amount of which is governed by the slip and design of the motor and is not dependent on the load so there will be considerable p.f. correction on the line which will help correct his present condition.—W.T.

A. TO QUESTION 255—In answer to W.H.L. concerning the conversion of a 70 kw., 2300, 3 phase squirrel cage motor into a generator, I would say that there are two good reasons *against* such a change.

In the first place, a true squirrel cage type alternating current motor has a rotor that is made up of merely copper bars, set into the rotor, which are short circuited on either end with solid rings making a solid practically one piece rotor assembly. This bar and ring assembly go to make up the only electrical circuit on the rotor, as there are no windings or coils as in other types of a-c machinery. This very low resistance circuit is the 'armature' of the squirrel cage motor and carries the induced currents of the rotor.

In the second place, replacing the rotor now of the squirrel cage type with one of the wound rotor type is impractical for the following reasons:

1. Small possibility of the manufacturer having *wound* rotors for that machine.
2. The necessity of new end plates or end-bells that would accommodate the longer wound rotor having the necessary collector rings for excitation purposes in a generator.
3. The lack of brush rigging, etc., to complete the excitation equipment.

W.R.S.

A. TO QUESTION 255—An induction motor can be used as a generator booster on a line that is energized, by driving the motor faster than its synchronous speed. Thus, for a 4 pole machine, 1800 rpm. would be synchronous speed, and full load motor speed might be 1700 rpm. or less.

For this same machine then if the motor has been started on the line, and power applied to cause it to revolve faster than 1800 rpm., the current will reverse and return energy to the system. Any prime mover such as diesel, steam, or gas engine can be used to turn the induction generator.

The full load current rating of the motor will be returned to the line at a speed of approximately 3% full load motor slip above synchronous speed. If the motor is rated at 40° rise for continuous operation, it can be used as a generator at 15% overload continuous.—E.E.E.

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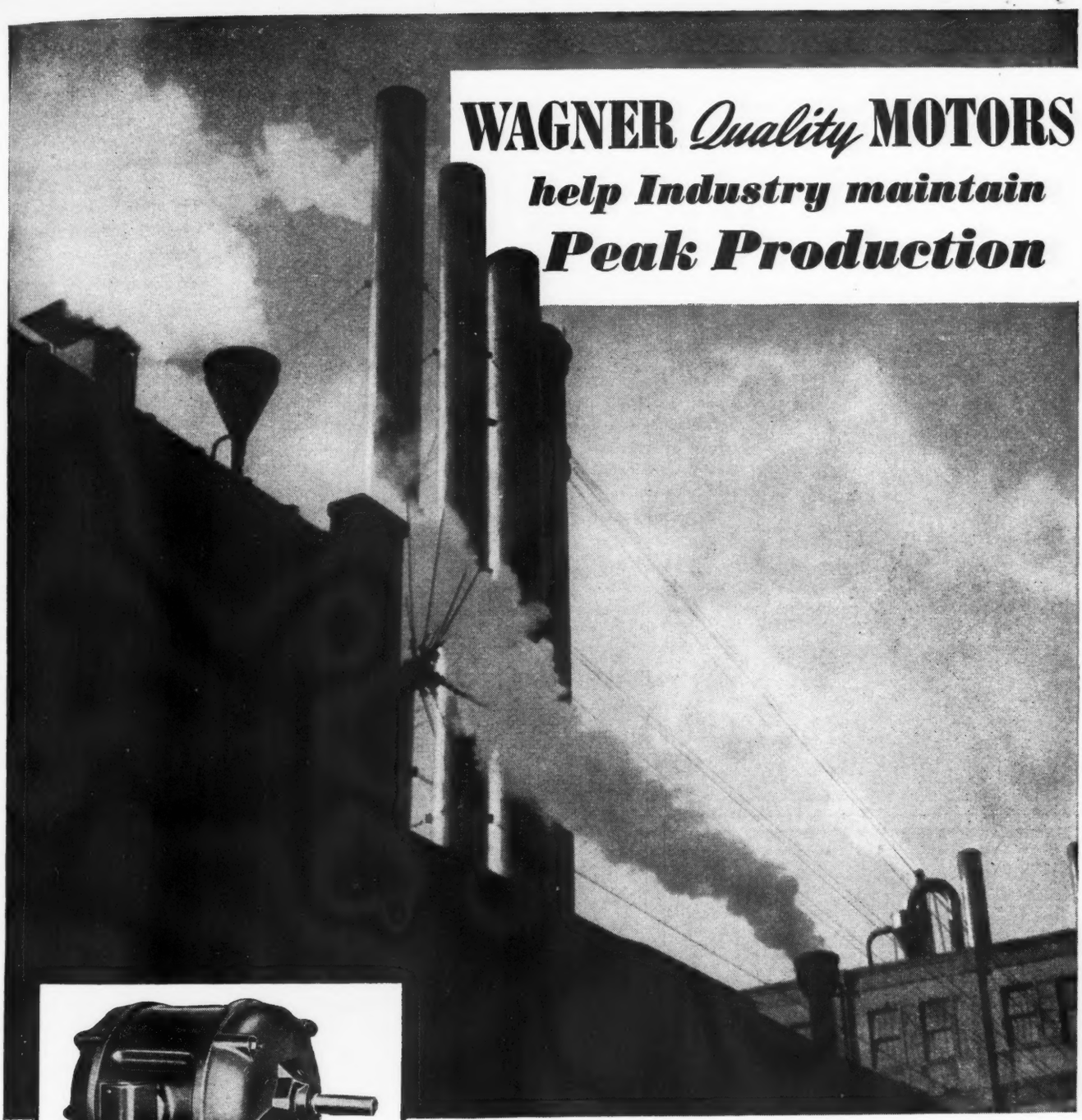

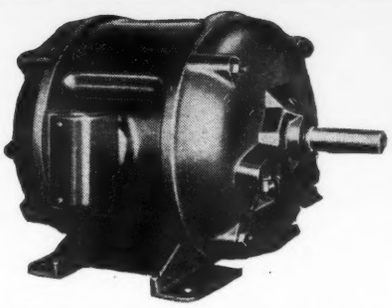

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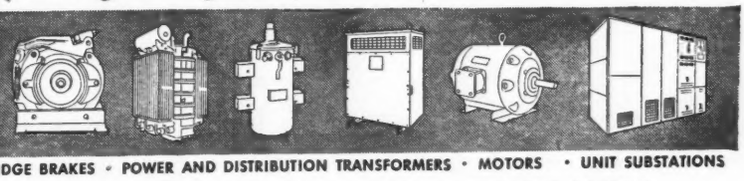

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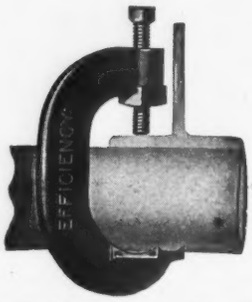

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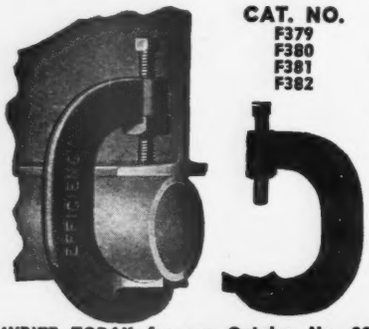

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CHANGING VOLTAGE

QUESTION 256—Under what conditions can a two speed, 3 phase, a-c motor 850 rpm. and 1150 rpm., winding be reconnected for 220 volts from the original 440 volts? Or is complete rewinding the only alternative?—E.J.K.

A. TO QUESTION 256—E.J.K. can have his 2 speed motor cut over to 220 volt provided it is wound in such a way that the coils can be broken and reconnected into a 2 parallel or 4 parallel delta or star. The idea is to connect it in such a way that the resistance is ½ what it is now per phase for 440 volt. There are several things to take into consideration in doing this job, and I suggest E.J.K. have a competent motor winder examine the windings and see if it could be done. If they are baked into a solid mass, it would be mechanically impossible to make the change. But if everything is open, it can be done. —J.F.

A. TO QUESTION 256—The torque produced in an induction motor is directly proportional to the magnetic flux, which in turn is proportional to the current in the coil. Therefore, if the connections are changed, they must be done so as to keep the same current per coil. We may make this adjustment to reduced voltage changes by:

1. changing coil connections from series to parallel.
2. by connecting poles per phase from series to parallel.
3. by connecting from start to delta all, or parts of, the coils or phases.

The change in each connection must be made so as to keep the current per coil the same regardless of the voltage.—G.J.J.

A. TO QUESTION 256—A 2 speed 2 winding 3 phase motor can sometimes be reconnected from 440 volts to 220 volt operation. The original motor connection and the pole combinations are the deciding factors in every instance.

For the case of a 2 speed 850 and 1150 rpm. (6 and 8 pole), the following connections may be used without getting into trouble with circulating currents. The 6 pole winding can be connected series, 2 parallel, or 3 parallel star or delta long throw. The 8 pole winding can be connected series, 2 parallel, or 4 parallel star or delta long throw. This is on the basis of equal coil grouping, so that there are the same number of coils in each parallel circuit.

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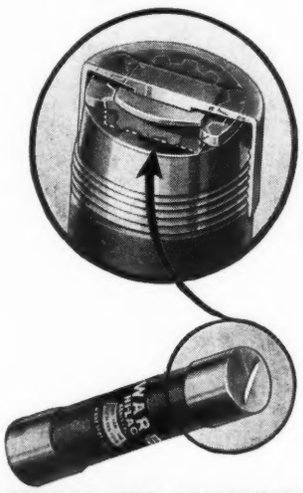

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Thus, in order to reconnect the 6 pole winding of a 440 volt 2 speed motor to 220 volts, and maintain the full motor rating, the original connection must be either a series star or delta connection. For 220 volt operation, it could be connected 2 parallel star or delta long throw, depending on whether the original connection was star or delta.

The 8 pole original connection for 440 volts can be either series or 2 parallel star or delta long throw. If series, it can be connected 2 parallel long throw star or delta for 220 volts. If 2 parallel connected for 440 volts, then 4 parallel long throw can be used for 220 volt operation.

A 6 parallel connection for the 6 pole, or an 8 parallel connection for the 8 pole cannot be used, either short or long throw.—E.E.E.

A. TO QUESTION 256—In operation at 850 rpm., either a 375 transformer tap or secondary on a 440 volt primary is utilized or a method of reconnection is used to operate it across 440 volts when the winding is suitable.

For instance, let us assume a 72 slot, 6 pole motor with coils spanning 8 slots. This pitch corresponds to a chord factor of Sine $\frac{1}{2}$ $(180 \times 6/72 \times 8) =$ 0.985. When reconnected 8 pole, the winding becomes therefore 0.985/0.866 = 1.14 times more effective. On the other hand, at the lower speed, the generated voltage is reduced to 6/8 or 75 percent. The net effect is a reduction of $1.14 \times 0.75 = 0.853$. Consequently, when the motor is connected 8 pole, its proper voltage rating will be $440 \times 0.853 = 375$ volts.

The 440/375 volt transformer may be eliminated if the 6 pole, 440 volt motor is designed with a two-parallel star winding for 1150 rpm. When reconnected 8 pole, series delta for 850 rpm., the winding becomes suitable for connection to a supply of $375 \times 2/1.73 =$ 434 volts. In the proposed reconnection, a two-parallel delta will make the motor suitable for 434/2 or 217 volts. At 1150 rpm. and 220 volts, the winding would have to be connected four-parallel star. A similar solution may also be worked out for a number of slots and pitch other than the values assumed in this example.—R.G.C.

Rewinding Motors

QUESTION 257—We have to rewind squirrel cage motors from 25 cycles to 60 cycles.

We know how to figure out number of turns and pitch.

In few cases we did not succeed, and manufacturer of motor said it could not be changed except in keeping number of poles same as on 25 cycles.

By counting number of bars on rotor and number of slots in stator, could we tell if it could be rewound for a change in number of pole?—H.R.

A. TO QUESTION 257—Changing motors from 25 cycle to 60 cycle usually necessitates the rewinding of the stators. In doing this, it is usually specified that the new speed on 60 cycle be as near to the 25 cycle speed as possible. This would mean that a two pole, 25 cycle motor, at 1500 rpm., synchronous, be wound for 60 cycle, four pole, 1800 rpm. synchronous. As the flux paths are proportional to the pole, therefore, the path would be increased by two under the above polar change and by four if the poles were increased to six giving 1200 rpm. synchronous.

This change of flux paths not only holds true to the stator alone, but also to the rotor. As maximum current is induced in the rotor bars directly under a stator pole, it follows a sine curve for each successive bar under any one pole of one polarity, and in the opposite direction for the opposite polarity stator pole.

The current in the end ring is maximum midway between poles and this current also follows a sine curve. As the rotor slip is proportional to the I^2R losses in the rotor, and keeping the ampere conductors per inch of periphery the same, the rotor bar losses will be about the same as before changing. The current paths through the rotor end rings have been increased with the increased stator poles, therefore, the ring resistance per pole has been reduced and the ring loss has also been reduced.

The starting torque of an induction motor depends upon the rotor resistance, for if large currents flow in the imbedded rotor bars, the inductance of these bars causes the current in them to lag so far behind the stator flux, that no torque is developed and nearly all of the power delivered to the stator is converted into heat.

A fairly accurate formula for the removal of end ring metal to meet the polar change is as follows: P^2 divided by P^2_1 times area of 25 cycle end ring equals area of 60 cycle end ring where P^2 equals poles for 25 cycles, P_1^2 poles for 60 cycle. Turn both rings to this new area and the operating performance will be satisfactory.—C.K.G.

A. TO QUESTION 257—Your question is not specific and can

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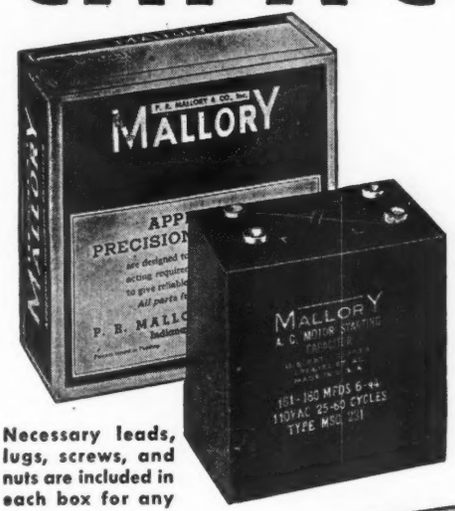

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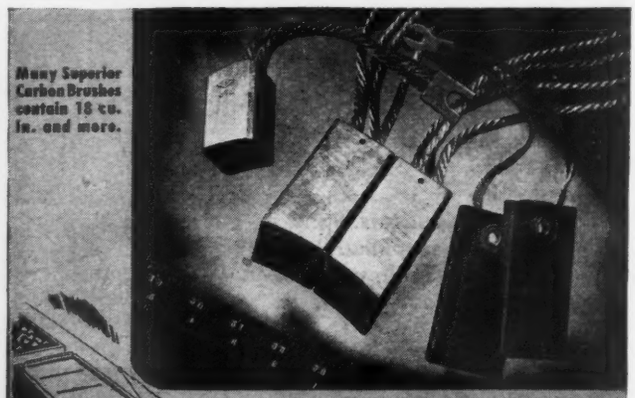

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only be answered in a general manner. Where a change of frequency is involved maintaining same speed, the number of poles must be changed in the same ratio as the frequency or as nearly as possible. Say a motor has 4 poles at 25 cycles giving a synchronous speed of 750 rpm. If the motor is to have the same speed at 60 cycles, the nearest possible pole number is 10 which would give a speed of 720 rpm. In the 4 pole winding the coil spans about $\frac{1}{4}$ the stator bore while in the case of the 10 pole about 1/10 the stator bore. Changing the span of the coil has an effect of changing the number of wires per coil. This limitation makes it quite impossible for the utilization of a 10 pole set-up when the coils have a four pole throw. Changing poles and frequency gets out of the practical field into the designers realm.

I would like to recommend "Alternating Current Armature Winding" by Croft—published by McGraw-Hill Book Company. Under "Reconnecting An Existing Stator Winding for Different Conditions", you will find an example illustrating your problem. It involves the reconnecting of a 25 cycle motor to 60 cycle keeping speed the same. The "Pitch Factor" is indicated as the critical point. It should not be smaller than 0.5 nor greater than 1.5.—E.A.M.

A. TO QUESTION 257 — The ability of the rotor to dissipate the heat loss originating in the rotor copper places electrical as well as mechanical limitations on speed. At a given maximum flux density, the 60 cycle motor will have a higher core loss than the same motor on 25 cycles.

The power factor of small low speed motors is low and is a function of the ratio of the reactive magnetizing kva. required to the kw. input required. The power factor depends therefore mainly on two factors:

First, the reactive kva. required to magnetize the air gap is proportional to the magnetizing current, the frequency, and other factors. The full load kw. input is proportional to the machine constants and the speed. The ratio of reactive magnetizing kva. to full load kw. input becomes therefore a function of g p/D, where D is the diameter of the rotor; p, the number of poles; and g, the air gap, which is made as small as possible consistent with safe mechanical considerations and may be neglected. For any given power output, therefore, the motor with the lesser number of poles, that is, with the lower frequency or higher speed, will have the higher power factor.

[Continued on page 153]

Second, the percent leakage reactance of the stator winding is chiefly a function of the number of slots per pole. In changing from 25 cycles to 60 cycles and selecting most probably a higher number of poles (60/25) to maintain the motor speed approximately the same, the number of slots per pole must necessarily be decreased. This will cause an increase in the leakage reactance which will cause the power factor to be lower.

Inasmuch as the physical dimensions of the motor are fixed and the diameter of the rotor cannot be increased in the same ratio as the number of poles to keep the magnetizing current and the leakage reactance unchanged, and the diameters of some of the rotors are evidently so dimensioned as to exclude any permissible increase in leakage reactance when the number of slots per is reduced, the motor cannot be rewound except for same number of poles or a number less than on 25 cycles.

Furthermore, an increase in the number of poles causes a decrease in the effective resistance of the end rings. While the cross-section of the end rings is constant, the length of end ring per path decreases as the paths in parallel and the number of poles increase. The net result is that the portion of rotor resistance due to end rings varies almost inversely as the square of the number of poles. R.G.C.

Can you ANSWER these QUESTIONS?

QUESTION XII—Have any of your readers had any experience in testing out tubes in industrial electronic control circuits with a neon lamp? If so, what is the proper procedure?—E.J.K.

QUESTION YII—How do you go about arranging the groups in a three phase induction motor, when the number of slots makes it necessary to have the coils in some of the groups, smaller in number than the rest.—F.H.L.

QUESTION ZII—I would like to hear from readers who have had experience in the use of aluminum bus bar clamps on copper bus and vice versa. I know the code, in section 3462, prohibits the use of dissimilar metals in raceways where subject to corrosion, and I would like to know to what extent aluminum clamps can be applied to copper bus in a fairly dry substation which is, however, ventilated by opening the windows in the building.—R.M.

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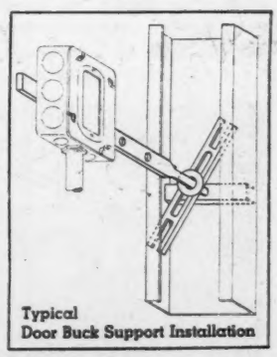
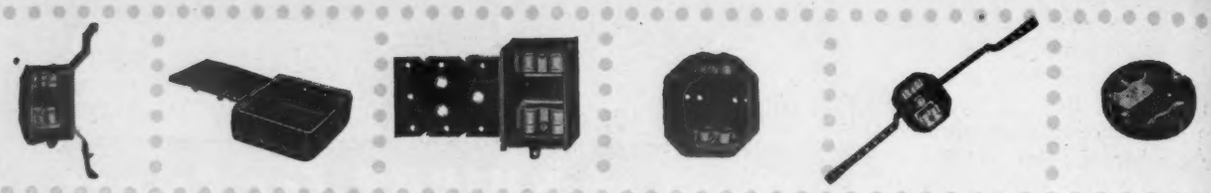


Typical Door Buck Support Installation



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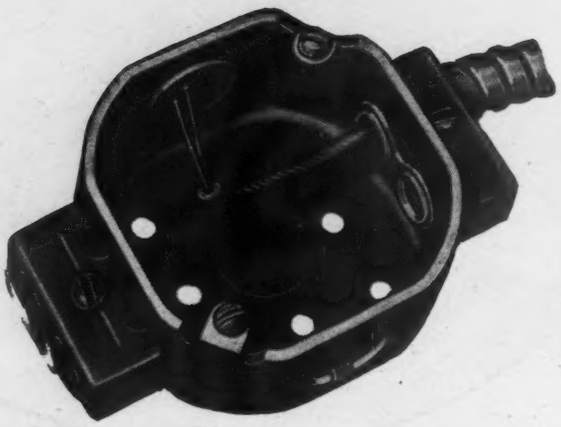

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Motor Shops

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FIG. 1—De-reeling rack that accommodates six large and four small reels of magnet wire. Wire goes through de-reeling arm and oil-line tubing raceways to winding head height.

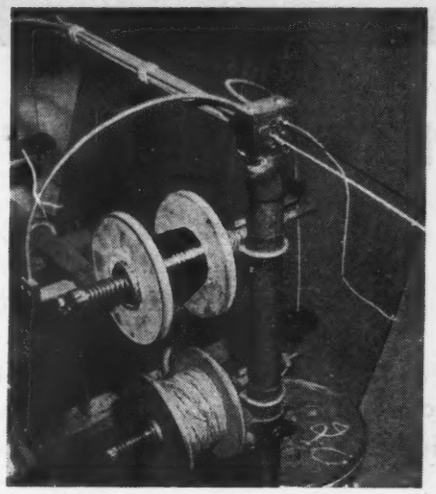

FIG. 2—Closeup of block at which tubing raceways converge. Block consists of three sections of 2½ in. by 1½ in. by ⅝ in. steel.

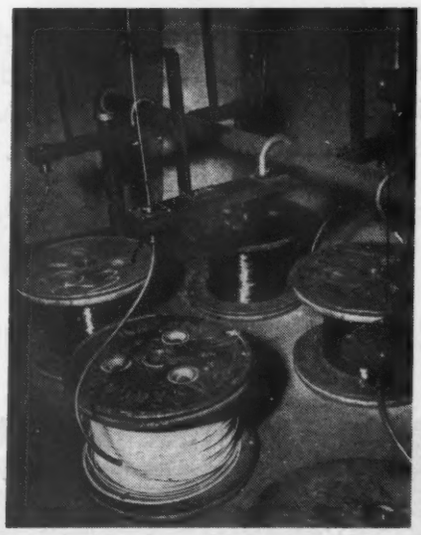

FIG. 3—Closeup of de-reeling arm and ball-bearing collar. Arrow points to collar extension for magnetic brake device if desired. Tubing rotates freely around reel as wire is being unwound.

Magnet Wire De-Reeler And Guide

With floor space at a premium, most motor repair shops frequently design and build equipment to suit their particular needs. Such was the case at Howard Electric Company, one of Detroit's leading motor service organizations. Among the numerous developments in this shop is a magnet wire de-reeler and guide designed and constructed by Douglas A. Gammage when he was shop superintendent.

The device, built around a central supporting pipe frame, is 20 inches wide, 53 inches long and about 36 inches high. Mounted to the center pipe support, on 18-inch centers, are three cross bars (2 in. by ¾ in.) which accommodate a ball-bearing mounted metal spool near each end. Fastened to the bottom of each spool is a 15-inch length of ¼-inch metal oil-line tubing, bent sickle-fashion so it will rotate around a reel resting on the floor. Each spool has an extended collar for use with a small magnetic brake if desired. (Fig. 3).

On top of each cross arm are two brackets (one on each side) which support oil-line tubing raceways that converge in a group at the front pedestal block at about winding head height (Figs. 1 and 2). Also mounted to this pedestal are two shafts on which can be placed four "spools" of smaller size magnet wire. Spring tension is utilized in this latter case.

Magnet wire from the six reels lying flat on the floor is threaded through the de-reeling arm, then through the top raceways which guide it to the level of the winding head. All tubing is flared at supporting junctions.

Although small magnetic brakes were at first considered to provide a tension at the de-reeling spool, these were found unnecessary. Apparently the friction of the wire going through the tubing raceways is sufficient to produce the small amount of tension needed. With the reels stationary on the floor, there is little chance of the wire becoming tangled while it is being unwound.

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Vertical Reel Rack

There is something about smooth running machinery, and efficient tools that fascinates Chris Dulsen. As owner and manager of Central Electric Company, motor repair shop in Cambridge, Mass., Chris insists on proper maintenance of all shop machinery and working tools, and encourages employee suggestions for any tools; machines, repair techniques, or other devices which will make work simpler or improve the appearance of his shop. Many of the machines in his shop have been suggested by employees, and subsequently designed and built right in his own shop.

Take the multiple reel rack shown in the accompanying picture. It holds ten 12-inch reels at one time. It is designed vertically to save floor space, and occupies a floor area of 40 inches by 40 inches. It is set back six feet from the winding machine, permitting wire from any reel to de-reel smoothly.

As can be noted in the picture, each reel rack arm is equipped with a revolving arm which holds an elbow-pipe made of ¼-inch brass tubing. The wire is threaded through this elbow and then through a bushed eyelet in the rack frame next to the winding machine. The bushed eyelets are properly positioned so that they are on a direct line from the reel rack arm and the winding head on the machine, to permit the wire to be de-reeled with a minimum of pull.

The idea for this de-reeling rack was conceived in the shop, then designed and made on the premises. The

Chris Dulsen of Central Electric Co., Cambridge, Mass., points out the brass pipe elbow on the revolving arm attached to each reel rack of a vertical wire de-reeler used in his shop. The rack was designed and built in his own shop.

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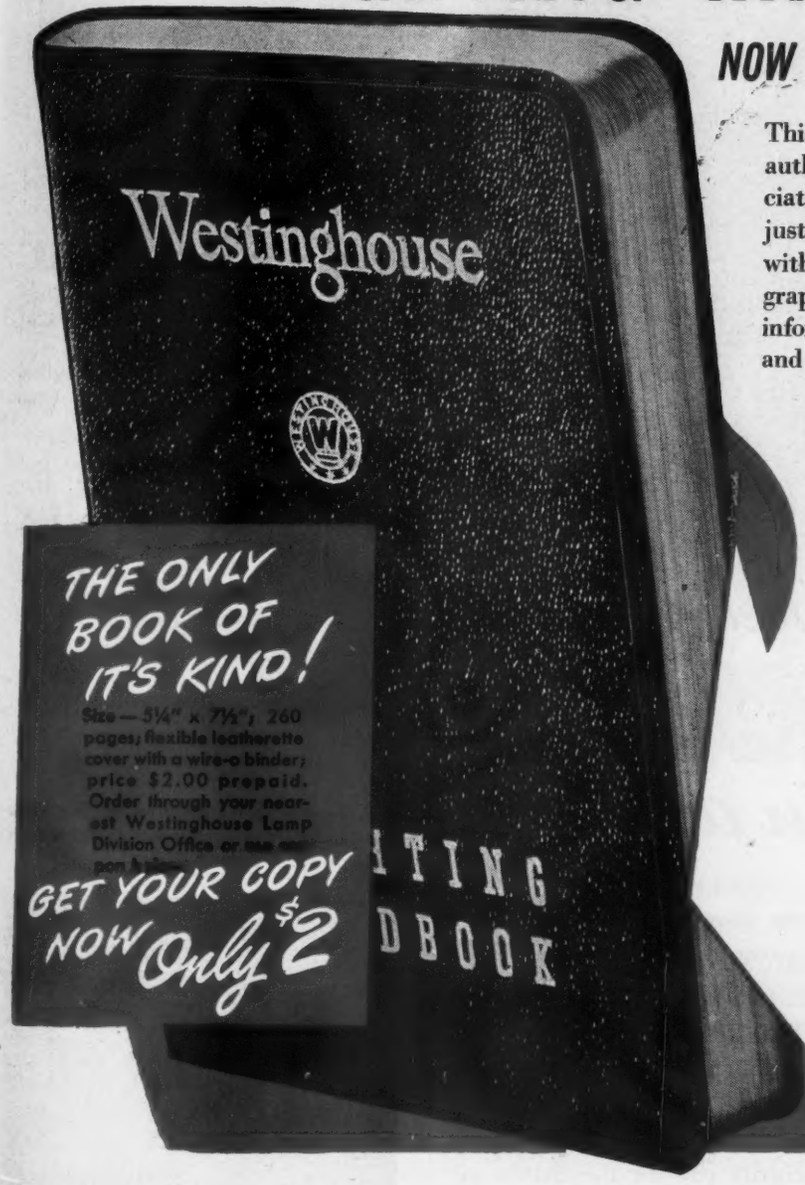
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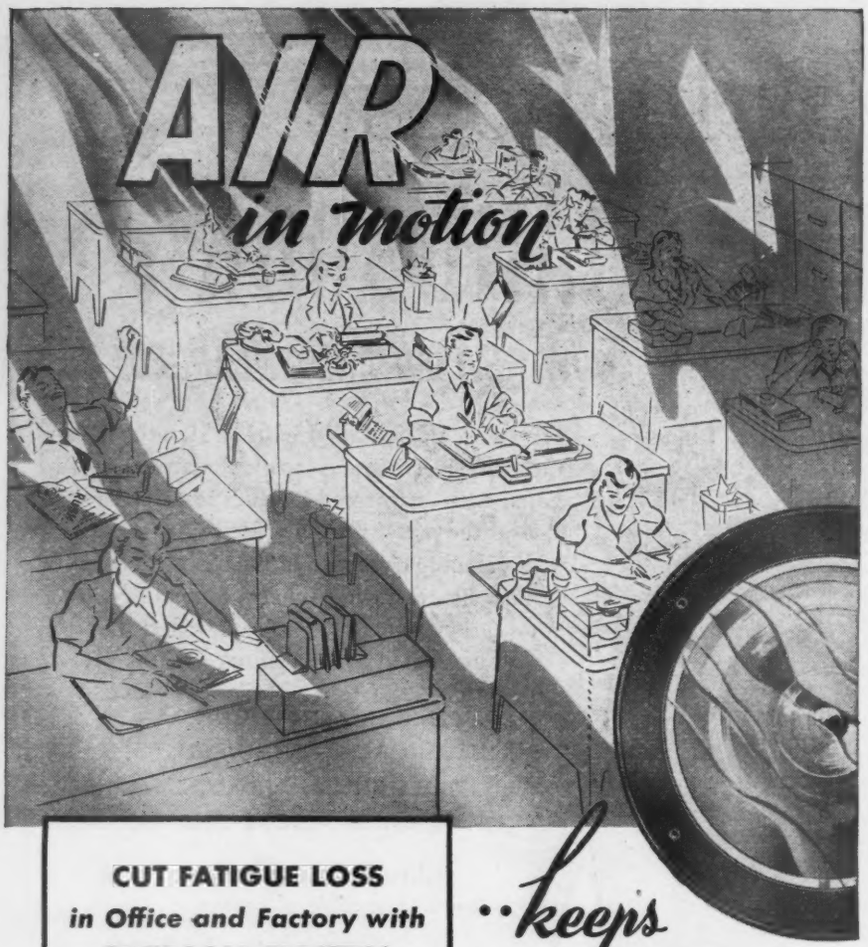

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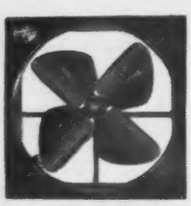

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frame is constructed throughout from angle iron. Reel rack arms are threaded bolts. The revolving arm works between bushings inserted one against the reel and the other on the outside of the arm, which is held in place by a large surface bearing nut. Pressure is applied by the large wing nuts to create the desired tension on the wire when rewinding.

Pry-Bar Removes Bearing Seal Rings

How many times have you struggled over the removal of oil bearing seal rings in the end bells of fractional horsepower motors? Normally an ordinary screw driver is used. Frequently this results in damaged knuckles or seal rings.

W. R. Mader of the Springfield Armature Works, Springfield, Ohio

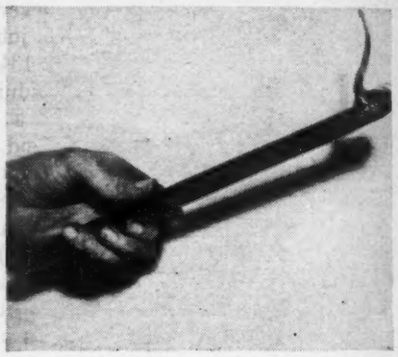

FIG. 1—Pry-bar designed by Mader to remove bearing seal rings in fractional horsepower motors.

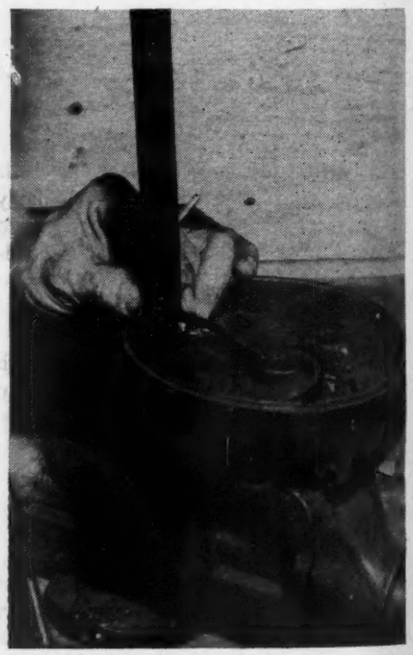

FIG. 2.—First step is to insert tongue of pry-bar hook under seal ring in end bell.

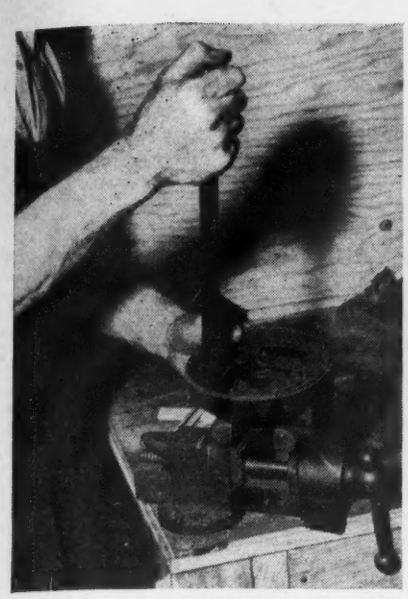

FIG. 3.—A slight backward pull on the bar and out comes the seal ring in a jiffy.

has solved the problem by designing a simple pry-bar that provides the leverage necessary to do a quick, clean job. The device (Fig. 1) consists of a 13½-inch length of round steel bar (conduit or pipe could also be used) with a 3 inch elongated steel hook on one end.

To remove a seal ring, Mader simply inserts the tongue of the hook under the seal and rests the bottom of the bar on the inside of the end bell (Fig. 2). When the bar is pulled back, the tongue raises the seal ring from its seat in the end bell (Fig. 3). It's as simple as that.

Mader's device has made such a hit that several shops in the vicinity have purchased pry-bars from him.

Lye Solution Softens Coils

Easiest way to remove old coils from stators and rotors, particularly those dipped in clear varnish, is to first boil them in a lye solution according to D. S. Leedom, shop superintendent, The Dayton Electric Service Co., Dayton, Ohio.

After trying several methods with varying degrees of success, Leedom built himself a heated solution tank. For average work, the solution consists of five pounds of a good brand of lye dissolved in twenty gallons of water. Sometimes a stronger mixture is necessary.

The equipment is dipped into the solution and kept at the boiling point for one to two hours. The resultant softening and decomposition of the insulation permits easy removal of the copper.

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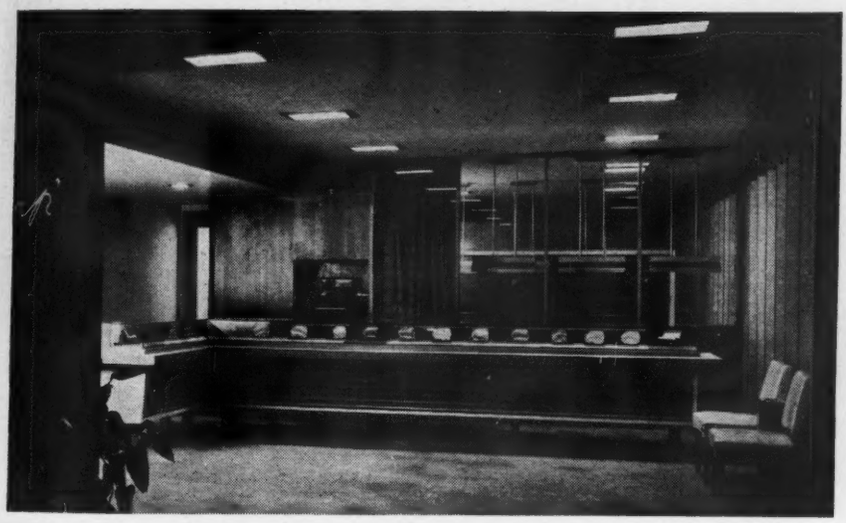

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Planned Lighting For Good Writing

Incandescent and fluorescent lamps are used in a variety of fixtures to provide both general diffusion and utilitarian concentration in the Eversharp offices, repair department and showroom located in New York City's Empire State Building. The air conditioned showroom, opening directly from the ninth floor corridor, is primarily illuminated by two rows of recessed, diffusing-lensed incandescent two-lamp units. Individual specular reflectors are provided for each lamp and the rectangular chromium frames are set flush with the acoustical tile ceiling. The spacing between rows is 8 feet while units in each line are mounted on 6-foot centers. This general illumination provides an average intensity of 20 footcandles.

Supplemental lighting behind display counters increases the illumination on merchandise and raises the average intensity to 35 footcandles in these areas. This supplemental illumination is also incandescent, lamps being mounted in recessed cylindrical metal housings containing glass reflectors and faced by diffusing circular lenses. Directly over sales and examining counters, ornamental totally-direct fluorescent units are suspended slightly lower than normal eye level, so that customers are not bothered by source brightness, and an impact of 65 footcandles is focussed where most desired. Wall displays are front and top lighted by swivel mounted, suspended spun metal bullet shaped spot reflectors.

Directly opposite the entrance is a lip lighted circular display window, set below the Eversharp trade mark which stretches across a curved panel of wood veneer. Executive offices, separated from the main salon by a plate glass wall, can achieve privacy by pulling the rich tan and green figured drapes across these windows. These offices are lighted by the same selection of fixtures employed in the main salon. The color scheme combines grey broadloom carpeting and red-brown painted wall surfaces with panels of natural wood. Designs for this Eversharp regional office were prepared by Raymond Loewy Associates, New York City.

Lighting A Jewelry Display Window

Jewelry store display windows present a special problem in lighting. These windows vary greatly in size and shape. Displays are usually of a wide variety of types of merchandise. Location of the windows and of the store with respect to main thoroughfares influence intensities required.

A unique solution to one jewelry store display window lighting problem is shown here. It was planned by Century Lighting, Inc., for Tiffany and Company, New York City. This store, located on New York's brightly lighted Fifth Avenue and 57th Street, is flooded with sunlight in the daytime. The architecture of the building is modern, and there are no window awnings. The windows, masked down by panels and drapes to an area approximately five feet wide, and 4½ feet high, with a two foot depth, are centered in large glass areas. Drapes and panels used are usually black or dark brown,

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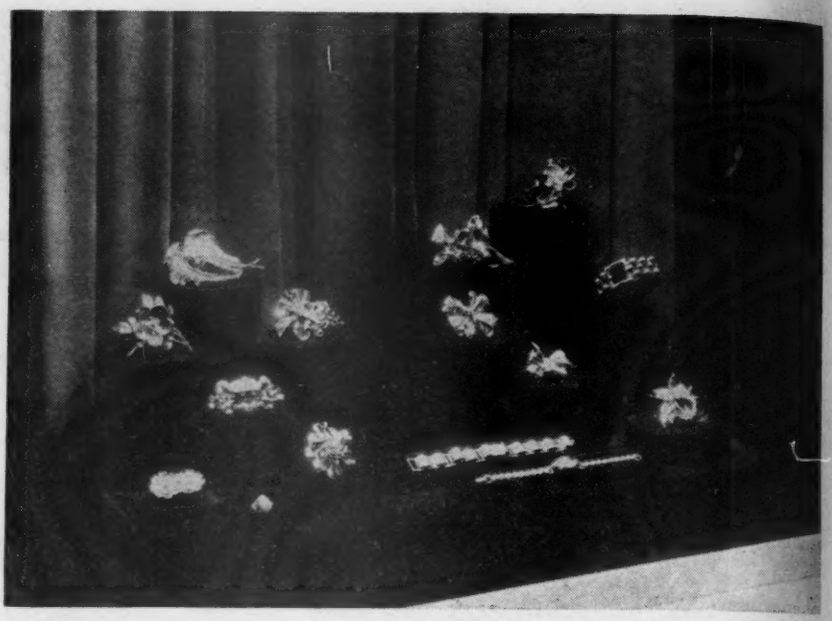
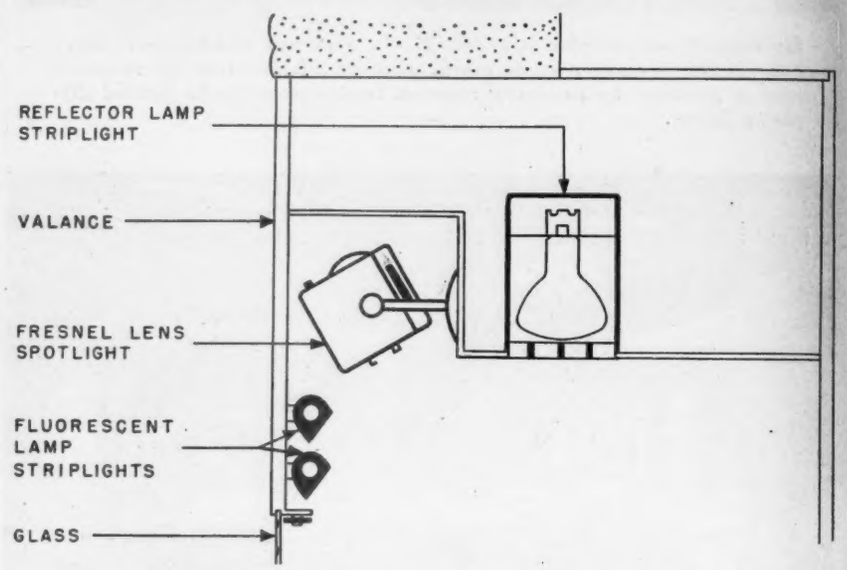


Jewelry sparkles in a window display at Tiffany and Company, New York City, when highlighted by six 150-watt fresnel lens spotlights.

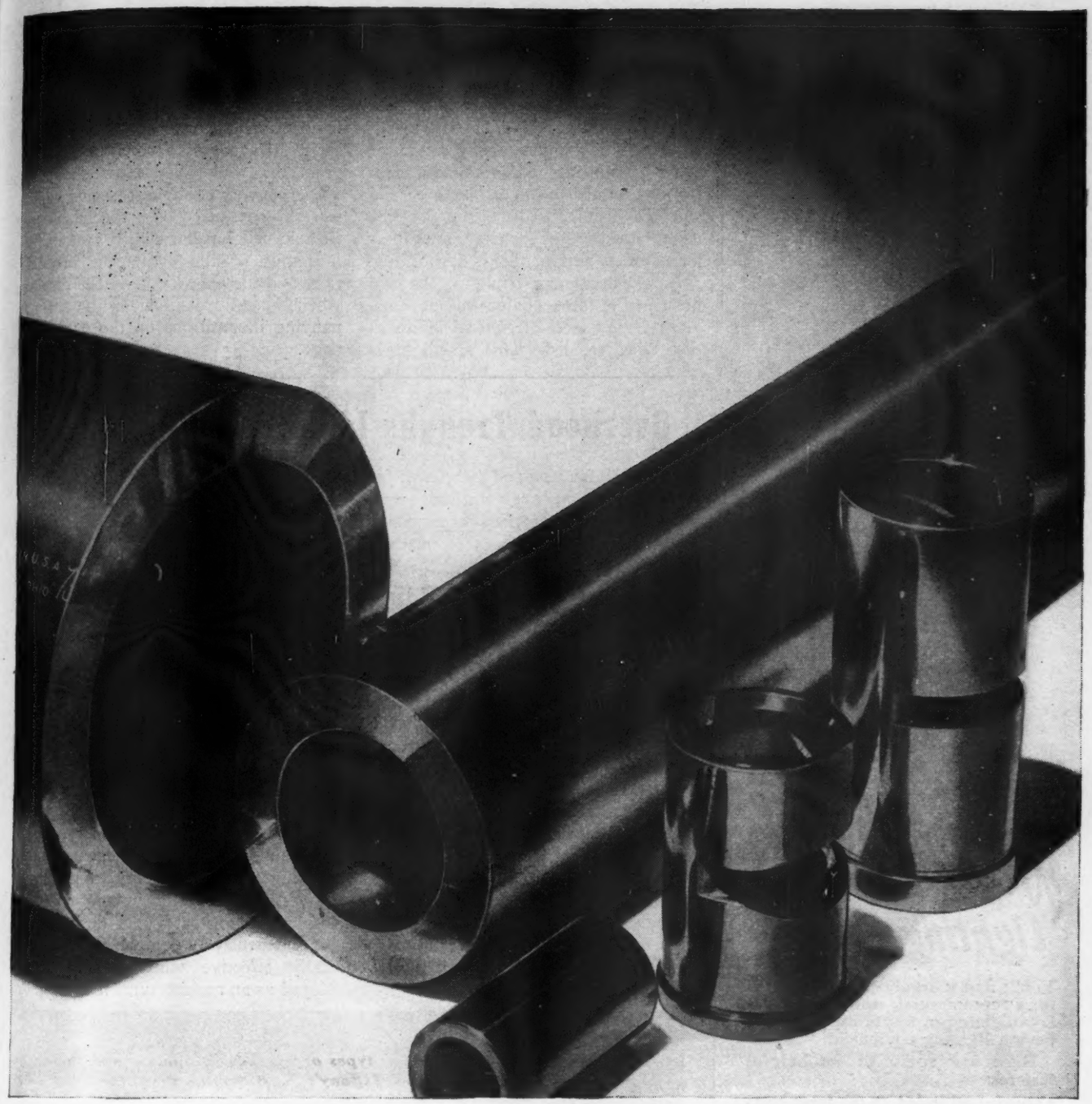


Cross section detail shows three types of lighting equipment and their location in a typical window of Tiffany's Fifth Avenue store, New York City.

and display stands are often the same. Merchandise displayed varies and includes jewelry, flat silver, leather, stationery, engraved announcements, glassware, china and other similar merchandise. Each requires different lighting treatment to provide the most attractive and attention-compelling lighting. Jewelry, such as gems and intricate metal work in platinum, white and yellow gold, for example, require a number of high intensity points of light for maximum display effectiveness. Silverware, leather goods, etc., require a high intensity of well diffused illumination.

Because of the large areas masked by the drapes and valance, there is sufficient space for completely concealing the lighting equipment. Because a wide variety of lighting effects are necessary, however, and because considerable time and effort would be required to change lighting equipment for the various types of displays, it was decided to use permanently installed equipments which would provide for the necessary variety of distributions of light needed. The specific lighting effect for any type of display can thus be obtained at will by means of flexible switching arrangement at the switch panels. This made it necessary to make the lighting units as compact as possible.

Each window is provided with six 150-watt fresnel lens spotlights, which may be focused to produce narrow high intensity beams, or adjusted to provide wider soft-edged floods of light. Each spotlight is also equipped with holders for glass color frames. These



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spotlights are normally used for lighting the jewelry displays.

Two rows of fluorescent lamp striplight are also installed in each window to provide diffuse illumination for silverware and similar displays. These are adjustable so that maximum light can be directed to the display area and shielded from the background. The use of two rows of lamps permits mixing colors whenever this is desirable.

A reflector lamp striplight, installed flush in the false window ceiling, provides a high level of general illumination when needed. This striplight is installed behind the spotlights and fluorescent lamp striplights, where it can be seen from the eye level on the sidewalk. For this reason the reflector lamp striplight was equipped with a series of louvers to shield the lamps from the view of window shoppers. These louvers continue a series which were also required by a special photoelectric cell burglar alarm system.

Details of the equipment installation, and the appearance of the display when lighted are shown in the accompanying illustrations on the preceding page.

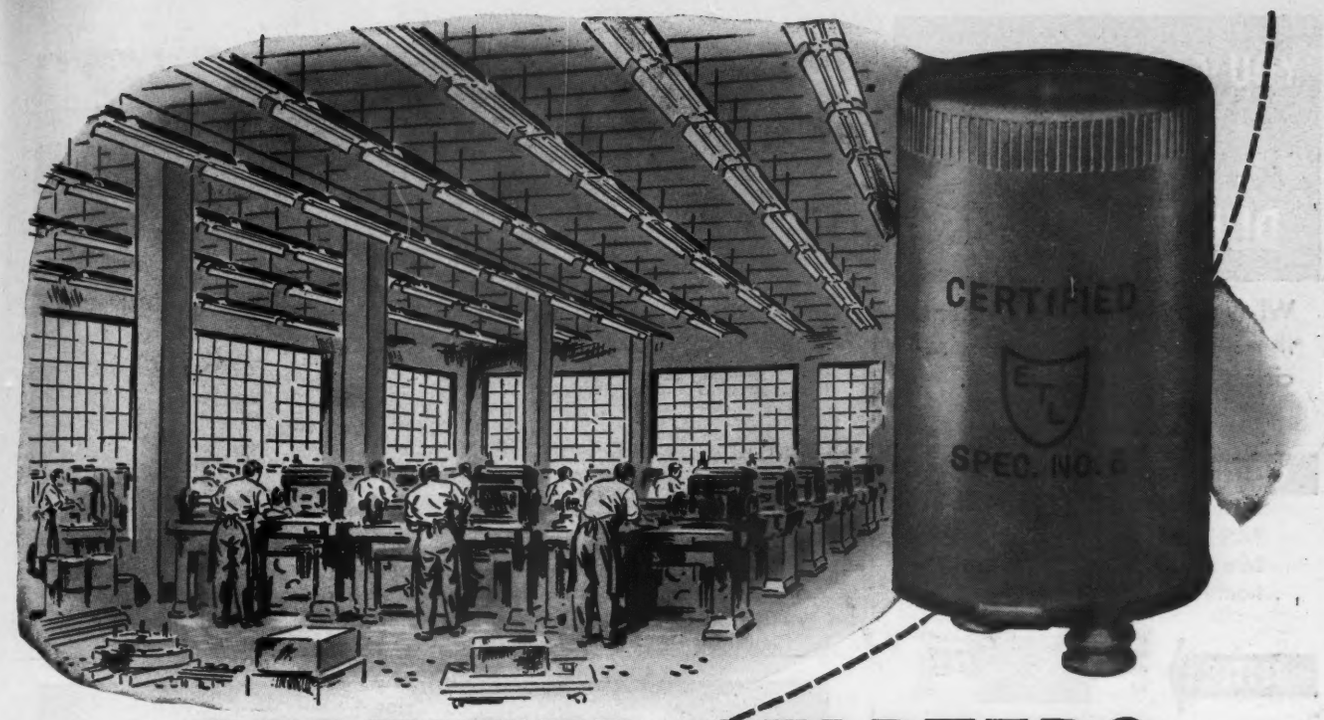
Overhead Troughs Light Home Products

In search for new and more effective sales promotion presentations, merchandising organizations are placing more and more emphasis on planned lighting as a major factor in this important field. Interest of prospective buyers is attracted and directed by the use of light. Quality of merchandise is emphasized by properly selected intensities and color. Glare is minimized by correct shielding.

As part of a store planning and sales promotion plan, the Frigidaire Division of the General Motors Corporation commissioned Raymond Loewy Associates, New York City, to create a series of displays that would emphasize the quality of their residential kitchen products. The resultant display, stressing simplicity of design, provides customer comfort and salesman convenience. The result is a skillful utilization of standard fluorescent lamps and accessories.

Refrigeration units, electric ranges and other household kitchen products are spaced before a continuous partition, the surface of which is treated with harmonizing pastel tints. Floor to ceiling vertical panels of plate glass, flanked by living plant arrangements, project from this partition at intervals to subdivide the display area into segments for the individual classifications of merchandise. Along the top is a continuous canopy, into which lighting troughs are recessed to house multiple lamp, shielded fluorescent reflector units. This single lighting source directs a soft, wide angle, even light to the products on display and creates a pleasant setting for salesmen demonstrating these items. Comfortable settees are for customer comfort. The display demonstrates that lighting can be inexpensively simple yet dramatically effective when skillfully employed as an architectural tool.

Recessed overhead troughs contain multiple-lamp fluorescent units that direct wide-angle even light to Frigidaire products on display. Convenience of salesman and comfort of customers is achieved in this display arrangement created by Raymond Loewy Associates.



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In large factories — as well as large offices and stores . . . wherever fluorescent lighting is a major factor, CERTIFIED STARTERS can help ease maintenance problems, help assure top lighting performance from lamps. • Certified Starter Manufacturers build their products to rigid specifications. Famous Electrical Testing Laboratories, Inc. test, check and recheck those products . . . CERTIFY them as fully meeting the specifications. It's a positive means of assuring the user of high quality starters — protection and economy. Insist on the "ETL CERTIFIED" shield on the starters you sell or use!

Makers of CERTIFIED FLEUR-O-LIER fixtures and RLM Standards Institute fixtures have solved their starter problems by writing CERTIFIED STARTERS into their specifications.

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Whatever your requirement, there is a P&S outlet — precision-built to do the job.

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P&S 1560 — All-Bakelite body — Laminated Bakelite back insulation.

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P&S 1565 — Same body as P&S 1560, but with wide mounting ears for easy alignment with wall surface.

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P&S 1530 — Positive one-piece contacts — Sturdy all-bakelite construction — wide mounting ears. T-slots. Meets REA and Federal specifications.

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A portion of A. O. Smith Corporation's Kankakee, Illinois plant where one of the largest single industrial fluorescent lighting installations in the Chicago area was made last year. Wadeford Electric Company installed 5,886 Leader ZUO-240 units that provide 35 to 40 foot-candles.

Deep type Guth recessed troffers are mounted in the marquee outside the entrance and store windows of Abrahamson-Bigelow Company, Jamestown, New York. Two 4-foot troffers, each containing two 40-watt white fluorescent lamps, are mounted in each unit. Units, 10-feet 4-inches above the sidewalk are spaced 5-feet center-to-center.

Tickets for Lighting Show

ADMISSION to the 2nd International Lighting Exposition at the Stevens Hotel, Chicago November 3 through 7th is by ticket only. For yours, send in the following coupon and your tickets will be forwarded promptly. There is no charge.

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Electrical Construction and Maintenance
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In the News

North Dakota Plans State-Wide Inspection

Highlighting the record 1947 annual meeting of the North Dakota Electrical Contractors' Association at Wahpeton in June was a discussion of state-wide electrical inspection. The system sponsored by the Association embodies the issuing of wiring affidavits similar to the Minnesota plan. Tentative financing of the program will be through sale of a book of ten affidavits for an initial fee of $25 (including inspection fee). Subsequent affidavit blanks will cost one dollar each.

Convention delegates unanimously approved the program which was subject to ratification by the North Dakota State Board of Electricians and became effective August 15th. Endorsed for the position of State Electrical Inspector was Frank M. Johnson, electrical inspector of Fargo. Proponents of the inspection plan were more than pleased to have the unqualified endorsement of Oscar Jacobson on behalf of the North Dakota REA Projects.

Reciprocal licensing between North Dakota and Minnesota was endorsed by the conference, but cannot be practiced. A ruling of the Attorney General of North Dakota finds that the State Board of Electricians has no authority to enter into such arrangements.

The advantages of membership in and the services offered by the Minnesota Electrical Council, Inc., were outlined by W. Arthur Starbird, president, and William A. Ritt, secretary of the Council. John Julsrud, new Council manager, was introduced to the group. The important function of the North Central Electrical Industries in electrical industry' product and service promotion was revealed by A. H. Kessler, manager of that organization. The administration of the North Dakota Electrical Law was reviewed by Otto Krueger, North Dakota State Commissioner of Insurance and a member of the State Board of Electricians.

Electrical code changes, both national and state, were reviewed by Glenn Rowell, Underwriters Inspection Bureau of Minneapolis, and George Garney of the Minnesota State Board of Electricity, while Frank Johnson, electrical inspector of Fargo, joined them in conducting a code question roundtable. Rounding out the two day session were illustrated talks by General Electric, Westinghouse and other jobber representatives.

At the business session, George C. Hilstad of Mayville, North Dakota, was elected president of the N.D.E.-C.A. Associated with him in official capacity for the coming year are the following officers and directors: vice-president Albert Bartsch, Rugby; secretary-treasurer Quentin M. Johnson, Fargo. Directors: Art Oksendahl, Rugby; Clyde Kieley, Grafton; Chester A. Brown, Dickenson; Dave Sink, Devils Lake; and Harold Kively, Carrington.

Re-elected as directors to the Minnesota Electrical Council were: Charles Wood, Fargo; Clyde Kieley, Grafton; and George C. Hilstad, Mayville.

The next winter meeting of the group will be held in conjunction with the electrical industry convention and trade show week early in March 1948 at St. Paul. The 1948 annual summer meeting is scheduled for Devils Lake, North Dakota.

Labor-Management Committee May Be Revived

Leaders of organized labor have joined management in expressing concern over the low state of productivity.

In the electrical contracting industry, it is expected that a joint committee of the National Electrical Contractors Association and the International Brotherhood of Electrical Workers, AFL, will be named to study the problem of production costs after the NECA Convention in San Francisco Sept. 8-10.

The industry already has designated this as the big problem to be considered by the convention. Marion H. Hedges, research director of IBEW, has suggested the idea of a productivity study with union cooperation.

NECA spokesmen indicate that it would be receptive to the suggestion. It might be accomplished through revival of the NECA-IBEW Labor-Management Committee, which has been inactive in recent years. This committee would go into the economics of the situation from the viewpoint of each side.

Mr. Hedges is vice-chairman of the National Planning Association's Labor Committee, which has issued a statement signed by 33 union leaders, both CIO and AFL. This statement recognizes that high wages stem from high productive efficiency, and that labor has as much at stake in higher productivity as management, consumers and stockholders.

The committee asks for joint labor-management cooperation in improving productive operations, particularly in overcoming restrictive practices on both sides. Labor, it says, can make a significant contribution to increased efficiency, but management must lead the way.

The statement sets forth two general principles:

1. "Workers must have assurance that the cards are not being stacked against them."

2. "Passing on of the benefits of increased productivity must be equitable and reasonably clear and certain."

Carolinas Chapter Elects NECA Officers

A five-man executive committee to work with other branches of the construction industry in an effort to lower construction costs and stimulate increased activity was named by the Carolinas chapter, National Electrical Contractors Association, in annual session, August 11, in Charlotte. This committee will act as liaison with other branches of the industry to bring about a more closely co-ordinated industry.

Hobert M. Bryant, of High Point, was elected to serve a second term as president, and C. W. Moseley, of Charlotte, former second vice-president, was advanced to first vice-president, and H. E. Austin, of Charlotte, was named second vice-president.

Officers re-elected included E. C. Peele, of Burlington, as secretary; J. C. Bolen, of Charlotte, as treasurer; R. K. Robinson, of Charlotte, as governor, and R. S. Huntington, of Greenville, S. C., as national counselor.

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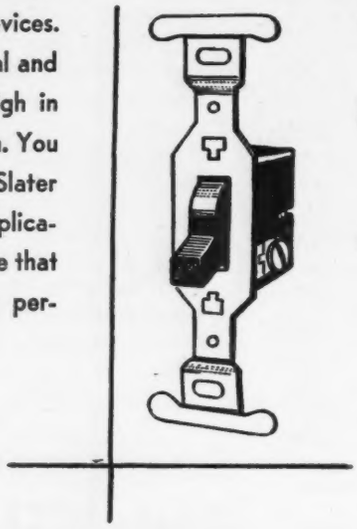

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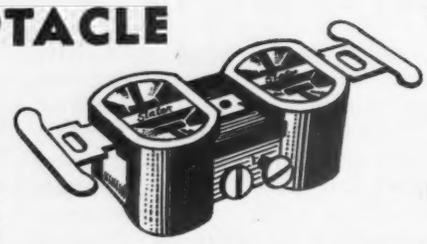

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REPRESENTATIVES IN PRINCIPAL CITIES

The five-man executive committee chosen included W. W. Hanks, of Charlotte; Lucian D. Webb, of Anderson, S. C.; J. W. Vaughn, of Durham; George Green, of Columbia, S. C.; and Joseph Dunn of Columbia, S. C. This past year Mr. Webb served as first vice-president of NECA.

At the evening banquet, Col. J. Norman Pease, of the J. N. Pease Company, delivered the principal address to guest architects and construction engineers and the host electrical contractors. Toastmaster was Roy A. Palmer, public relations officer for Duke Power Co. A lifetime honorary membership was presented to Oliver W. Holmes of the Holmes Electric Company of Fayetteville.

Kessler Named Manager of NCEI

A. H. Kessler was appointed manager of the North Central Electrical Industries to succeed William A. Ritt, who resigned after serving in this capacity since the inception of the organization in 1936. Mr. Kessler, over the same period, has held the position of promotion manager.

H. E. Young of Minneapolis, was re-elected chairman at the annual meeting of the board, with R. F. Pulver of Duluth and Wm. G. Stuefer of Minneapolis, vice presidents; L. G. Mample of St. Paul, treasurer, and William A. Ritt of St. Peter, secretary.

S. D. Group Joins Minnesota Council

Formal application of the newly organized South Dakota Electrical Contractors Association for affiliation with the Minnesota Electrical Council was recently approved by the Board of Directors of the latter group. Full affiliation is expected to be completed by February, 1948, thus adding some 40 or more members to the Council roster.

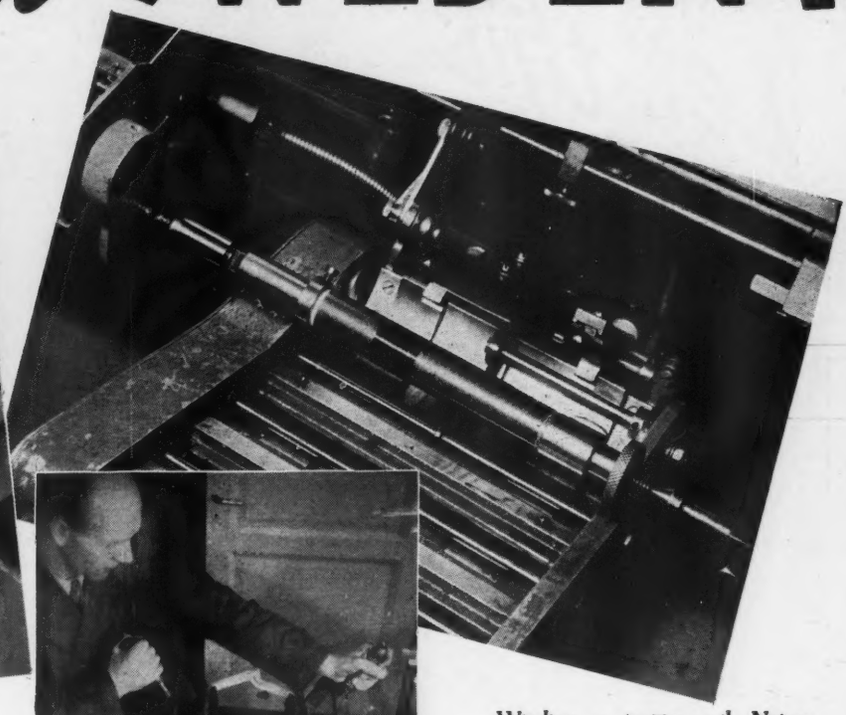
There is also an indication that several members of the recently organized Northwest Iowa Electrical Contractors Association (84 members at present) would like to have their group join the Council.

Such addition of out-of-state groups is a logical move since they are within the trade area served by the Minnesota Council. Also, it is evidence of the outstanding service the Minnesota association offers its members.

The addition of the South Dakota

NATVAR *in* SWEDEN!

Taping a flat copper strip of magnet wire with Natvar Varnished Fiberglas Tape—a continuous operation.



Winding an ignition coil. Natvar Varnished Paper is used between soft iron core and Bakelite tube.

Rectangular copper conductors, insulated with Natvar Varnished Fiberglas Tape, are wound into coils. They are then formed for installation in locomotive motors.

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For important jobs, large or small, Natvar insulating materials are used because in actual service they consistently equal or exceed specifications.

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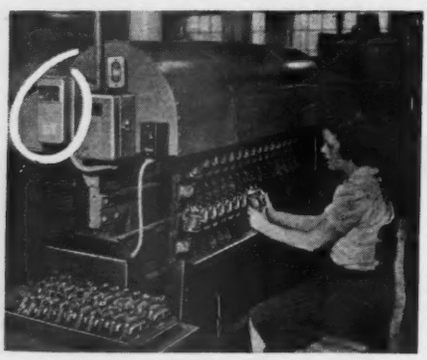

Here a T-27 controls movement of a chain conveyor through an electric oven —one of a complex cycle of time-switch-controlled operations in the manufacture of meter coils.

The T-27 is a versatile time switch equipped to handle a variety of jobs. Use it to turn ovens "on" and "off" at exactly timed intervals . . . to operate ventilating fans and blowers . . . to turn heating units on early so that they will be ready for use when workers arrive. Or let it control drying and curing processes after hours, without the attention of an operator.

It can do these and dozens of other timing jobs for you tirelessly and efficiently. It is a COMPLETE time switch . . . "complete" in that it is designed to handle almost any type of time-control assignment. Put the T-27 to work for you and benefit from the added economies. Ask the nearest G-E Office for further information, or write for Bulletin GEA-3339. *Apparatus Department, General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

603-49

association as a sponsoring group has raised the question of a change in name for the Minnesota Electrical Council. Upper Midwest Electrical Council has been suggested as a more appropriate name, since the North Dakota Contractors Association already are members. Such action has been referred to the Council Policy Committee for consideration and any decisions will be subject to the approval of the Council Board of Directors and the general membership.

Julsrud Succeeds Ritt As Council Manager

John E. Julsrud of Minneapolis was appointed manager of the Minnesota Electrical Council, Inc., at a recent meeting of the Board of Directors. He succeeds Wm. A. Ritt who asked to be relieved of some of the load he shouldered as manager of three expanding electrical associations in Minnesota as well as his own contractor-dealer business in St. Peter.

Bill Ritt has gained national recognition for the outstanding job he has done in organizing the various components of the electrical industry in Minnesota into closely-knit cooperative groups. The post he now relinquishes was taken on as a "temporary" chore some 14 years ago when the Council was organized. Membership now approaches the 550 mark. Bill will continue as secretary of the Council on a part time basis to assist in planning for the growing needs of the Council.

Mr. Julsrud brings to the Council 14 years of experience in various positions with General Mills, Inc. He started with the company in 1930 doing bookkeeping and statistical work, followed by experience in milling, engineering and processing. While at Oklahoma City in 1936, he was admitted to the practice of law and served as attorney for the Southwestern Division of General Mills from 1936 to 1941. From 1941 to 1943, he served with the Federal Bureau of Investigation as special agent at Chicago on sabotage and espionage cases. At the time of his appointment to the Council, he was staff assistant in the Industrial Relations Division of General Mills.

Johnson Heads Chicago IES

Charles E. Johnson, Chicago sales manager, Curtis Lighting, Inc., was

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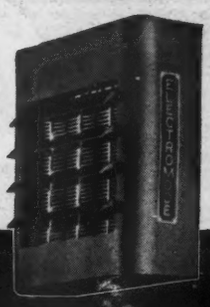

Illustrated: Electromode Suspension Type Unit Heater

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Heavy Duty Combination Portable and Suspension Type Heater. May be plugged in wherever heat is needed. Capacities: 3 to 7.5 KW.

As auxiliaries to the main heating plant, Electromode All-Electric Unit Heaters have many advantages for the economy-minded factory man. They require no plumbing connections . . . cut maintenance costs tremendously. They lose no heat in transit... are ideal for outlying locations. They use current only when heat is needed. And they save the cost of operating the main heating plant when only certain departments are working.

These all-electric heaters may be used safely anywhere—even where open wire heaters are not permitted. Their patented, cast-aluminum Safety-Grid have no exposed hot or glowing wires —supply abundant, fan-driven warmth without danger of fire, shock or burn.

There are Electromodes for every industrial purpose—from 1.5 to 60 KW—also portable and built-in wall heaters for home and office. All are approved by Underwriters' Laboratories. We invite contractors to see their electrical wholesaler or write Electromode for further information.

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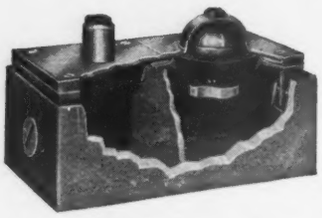
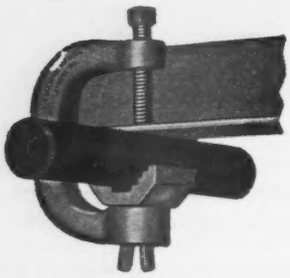
Ideal for use in wood installations and other moisture-free locations.



No. 252-R Floor Box

A two-gang box with No. 208 Receptacle in one section. One cover plate with ½" flush brass plug.—the other 2".



No. 471 "Latrobe" Pipe or Conduit Hanger

High quality and sure performer yet very economical for hanging pipe or conduit to steel beams. Takes pipe ½", ¾" and 1".

No. 110 "Latrobe" Watertight Box

The box body is Iron with 3 ½" round Brass cover plate. No. 208 Receptacle and No. 207 Bull Nozzle.

***"Bull Dog"* BX Cable Staples**

We can furnish these high quality staples in any quantity. Packed in cartons, kegs or barrels.

Sold Only Through Wholesalers

Keystone Fish Wire

Flat and of high quality properly tempered steel.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

recently elected chairman of the Chicago Section, Illuminating Engineering Society. Other officers are vice-chairman Glen G. Boyd, illuminating engineer, Public Service Company of Northern Illinois, Joliet, and secretary Ralph R. Cheney, metropolitan sales manager, Westinghouse Lamp Division, Chicago.

Kieley On N. D. State Board

Clyde Kieley, electrical contractor of Grafton, N. D., and past president of the North Dakota Electrical Contractors Association, is the newest member of the North Dakota State Board of Electricians. He was appointed by Governor Andahl to succeed Bob Melville of Bismarck who recently resigned.

DATES AHEAD

Illuminating Engineering Society—Annual convention, New Orleans, La., September 5-10.

National Electrical Contractors Association—Annual meeting, Palace Hotel, San Francisco, Calif., September 8-10.

Illuminating Engineering Society—Technical Conference, Roosevelt Hotel, New Orleans, La., September 15-19.

International Association of Electrical Inspectors—Northwestern Section, Eugene Hotel, Eugene, Ore., Sept. 22-24; Southwestern Section, Mission Inn, Riverside, Calif., September 29-October 1; Western Section, Mount Royal Hotel, Montreal, Quebec, Canada, October 13-15; Eastern Section, Seaside Hotel, Atlantic City, N. J., October 20-22; Southern Section, Hotel George Washington, Jacksonville, Fla., October 27-29.

International Municipal Signal Association, Inc.—Annual meeting, Pantlind Hotel, Grand Rapids, Mich., September 29-October 2.

National Safety Congress & Exposition—Chicago, Ill., October 6-10.

First Annual Cold Cathode Fluorescent Lighting Exhibit—Hotel Commodore, New York, N. Y., October 7-9.

National Farm Electrification Conference—Claypool Hotel, Indianapolis, Ind., October 7-8.

International Association of Electrical Leagues—12th Annual Conference, Statler Hotel, St. Louis, Mo., Oct. 8-11.

American Standards Association—Annual meeting, Waldorf-Astoria Hotel, New York, N. Y., October 21-23.

National Electrical Manufacturers Association—Traymore Hotel, Atlantic City, N. J., Week of Oct. 26.

National Electronic Conference—Edgewater Beach Hotel, Chicago, Ill., November 3-5.

American Institute of Electrical Engineers—Midwest meeting, Chicago, Ill., November 3-7.

2nd International Lighting Exposition—Hotel Stevens, Chicago, Ill., Nov. 3-7.

National Metal Trades Association—Palmer House, Chicago, Ill., November 6-17.

National Association of Manufacturers—Waldorf-Astoria Hotel, New York, N. Y., December 3-5.

Fifth All Industry Refrigeration and Air Conditioning Exposition—Public Auditorium, Cleveland, Ohio, January 26-29.

American Institute of Electrical Engineers—Winter general meeting, William Penn Hotel, Pittsburgh, Pa., January 26-30.

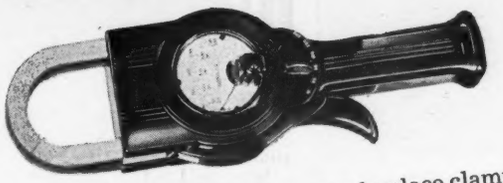
8th International Heating and Ventilating Exposition—Air Conditioning Exposition, Grand Central Palace, New York, N. Y., February 2-6.

National Electrical Manufacturers Association—Winter Convention, Edgewater Beach Hotel, Chicago, Ill., March 14-18.

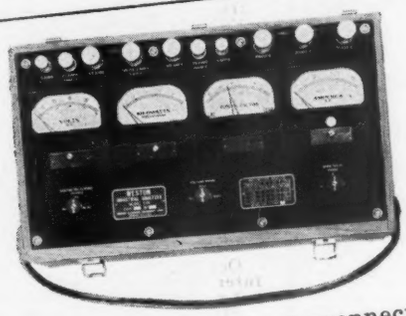
Chamber of Commerce—Annual meeting, Washington, D. C., April 27-29.

National Electrical Wholesalers Association—Annual convention, Statler Hotel, Buffalo, N. Y. First week in May.

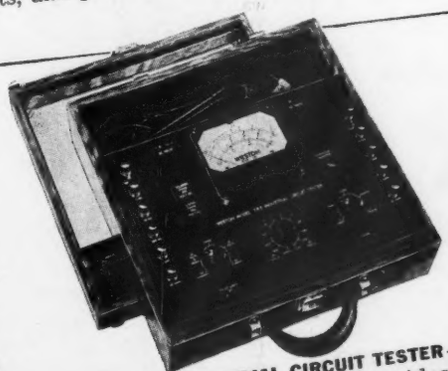
TIPS on off-setting rising production costs!



MODEL 633 AC CLAMP AMMETER—simply place clamping jaws around conductor (insulated or bare) for current measurements. Circuits never disturbed.



MODEL 639 POWER ANALYZER—all interconnections made for quick load analysis . . . measures current, voltage and power in single and polyphase circuits, and power factor in 3-phase circuits.



MODEL 785 INDUSTRIAL CIRCUIT TESTER—for maintenance or laboratory needs. Provides 27 AC and DC voltage and current, and resistance ranges. (DC sensitivity 20,000 ohms per volt.)

Look to improved electrical maintenance to help off-set rising costs. Check circuits and all electrified equipment regularly. Efficient power utilization alone will save a tidy sum. In addition, you eliminate breakdowns and get higher output per machine as well.

WESTON has the instruments you need for efficient maintenance . . . all designed to simplify and speed-up testing procedure. Ask your local WESTON representative for recommendations, or write for literature... Weston Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey.

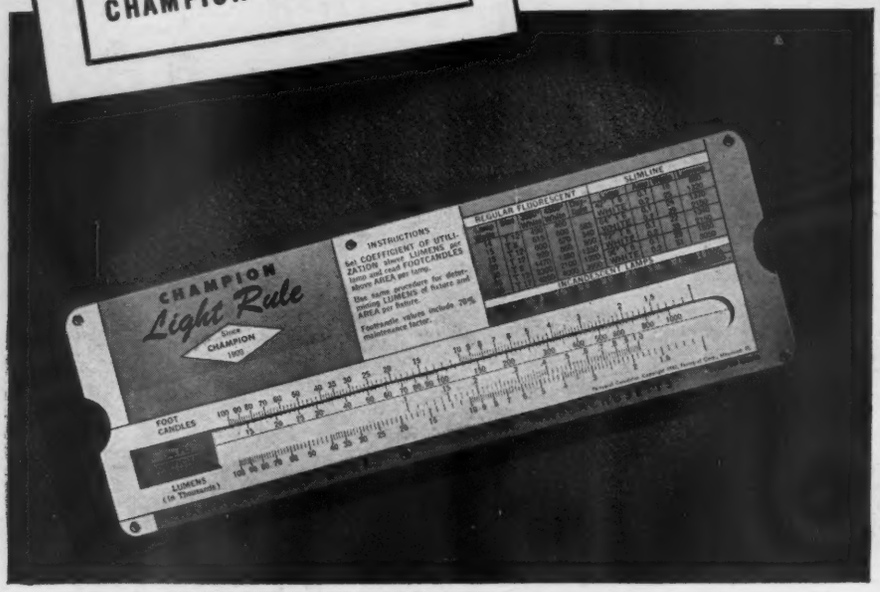
WESTON

Instruments

ALBANY · ATLANTA · BOSTON · BUFFALO · CHARLOTTE · CHICAGO
CINCINNATI · CLEVELAND · DALLAS · DENVER · DETROIT · JACKSONVILLE
KNOXVILLE · LITTLE ROCK · LOS ANGELES · MERIDEN · MINNEAPOLIS
NEWARK · NEW ORLEANS · NEW YORK · PHILADELPHIA · PHOENIX
PITTSBURGH · ROCHESTER · SAN FRANCISCO · SEATTLE · ST. LOUIS · SYRACUSE
IN CANADA: NORTHERN ELECTRIC CO., LTD., POWERLITE DEVICES, LTD.

With the Compliments of the
CHAMPION LAMP WORKS

One To Each Electrical Construction & Maintenance Reader



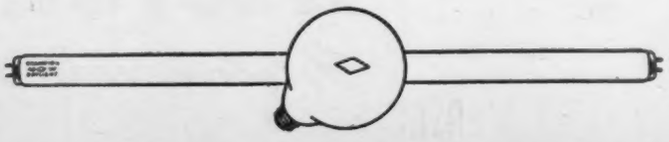
A CHAMPION *Light Rule*

The New, Simplified Lighting Calculator

Write today, on your company letterhead, and the makers of CHAMPION Quality **Fluorescent** and *Incandescent* Lamps will send you one of these handy, useful, pocket Light Rules.

Completely new and different, the Champion Light Rule gives you foot candles, lumens per lamp or fixture, area per lamp or fixture at a single setting of the slide. It's the only Lighting Calculator that applies to any type of lamp or fixture without reference to catalog numbers.

You'll have to see and try out this Light Rule to appreciate its practical utility. It's yours for the asking when requested on your company letterhead. Write Department A.



CHAMPION LAMP WORKS
Lynn, Massachusetts
A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.

MANUFACTURERS NEWS

G-E APPOINTMENTS

W. V. Merrihue has been appointed manager of community and employee relations for the General Electric apparatus department. As a member of R. C. Muir's staff, Mr. Merrihue will be in charge of policy pertaining to community and employee relations for the department. He relinquishes his post as manager of the advertising and sales promotion, apparatus department.

J. S. Smith has been named to succeed Mr. Merrihue. Mr. Smith was formerly manager of visual education division of advertising department.

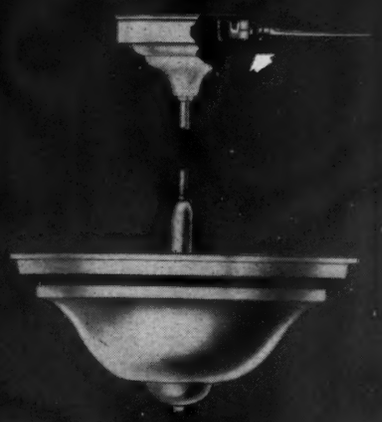
W. V. MERRIHUE

J. S. SMITH

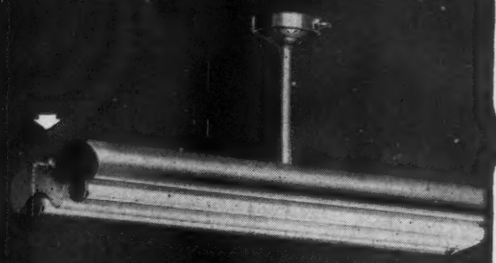
The marketing organization of the appliance and merchandise department has been reorganized. Under the new setup, all of the department's marketing activities are coordinated under a manager of markeing, C. R. Pritchard, whose former position as general sales manager of the department has been discontinued. In his position as staff representative of Mr. Andrews, Mr. Pritchard will be responsible not only for all direct sales activities of the department, but also for consumer, market and distribution research, advertising and promotion.

The former three broad sales divi-

ESPECIALLY ADAPTABLE ON

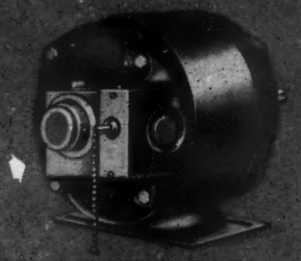


Lighting Fixtures



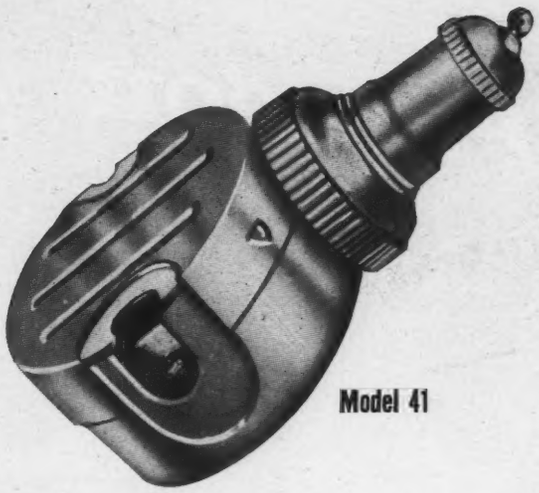
Fluorescent Lighting Fixtures

Ventilating Fans



Electric Motors

INDIVIDUAL CONTROL By McGILL *Levolier* SWITCHES



Model 41

ADDS TO LIGHTING LIFE . . . INCREASES THE EFFICIENCY OF ELECTRICAL DEVICES

Dependable, inexpensive McGILL *LEVOLIER* SWITCHES provide the SELECTIVITY that enables you to choose only the lighting fixtures needed . . . giving others on the same circuit a "time-out" period that ADDS to their lighting lives . . . SUBTRACTS from your power costs.

At the rate of only 4c per kilowatt hour, the saving of one kilowatt means $96.00 for a year of 300 work days of 8 hours each. Multiply this figure by the number of needlessly burning lamps to see what *LEVOLIER* INDIVIDUAL CONTROL can save for you.

In the field of electrical devices such as variable speed motors, ventilating fans, sign flasher boxes, and transformers, *LEVOLIER* SWITCHES provide CONVENIENT, POSITIVE control where control is often otherwise inaccessible.

LEVOLIER Model 41, shown above, is the smallest 6 amp. pull switch made, yet has unusual capacity.

Let *LEVOLIER* INDIVIDUAL CONTROL SWITCHES help you economize on power . . . cut maintenance costs . . . add to lighting life . . . and increase electrical efficiency.

Ask your Wholesaler about LEVOLIER Switches.

ONLY McGILL MAKES *Levolier* SWITCHES

McGILL MANUFACTURING COMPANY, INC.

Electrical Division

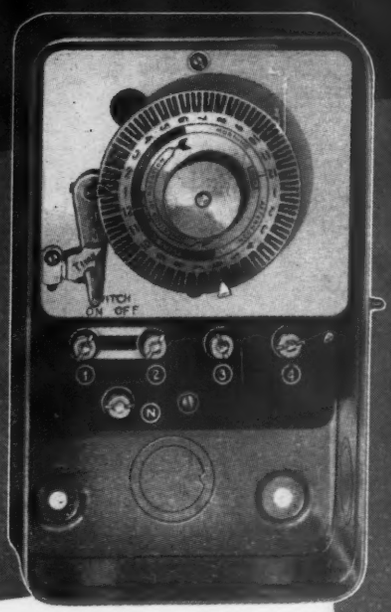
VALPARAISO, INDIANA

THERE'S *NO BETTER* CONTROL

Paragon

Two Rivers WISCONSIN

BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905



300 SERIES FROM $11.75 LIST

BETTER CONSTRUCTION

Easier Maintenance

Underwriters Approved . . . Telechron Motored . . . Paragon Engineered . . . this is your assurance of better construction and easier maintenance of your installations. The 300 Series featured above are very popular . . . especially ideal for Window and Sign Lighting, Stokers Oil Burners, Pumps, Valves. Ask your jobber or write us for details.

700 SERIES . . . 7 Day Dial Time Switch . . . setting for each day in week. For Automatic Heating, Ventilating, Air Conditioning. From $24.50 list.

PS-30 SERIES . . . Poultry Time Switches for permanent installations. With provision for bright and dim circuits. $13.50 List.

THE PLUG-IN. New . . . welcomed by Poultry Raisers because of simple and easy installation. Portable. $14.95 List.

LIBERAL TRADE DISCOUNTS

PARAGON ELECTRIC CO. TWO RIVERS, WIS.

sions of the department, covering major and traffic appliances and construction materials, have been consolidated into two divisions covering appliances and construction materials.

A. M. Sweeny, who was manager of major appliance sales, becomes manager of all appliance sales. C. W. Theleen, formerly manager of traffic appliance sales, is named assistant manager of appliance sales.

J. H. Crawford continues in his former capacity as manager of construction materials sales.

F. M. Falge, who last June was promoted to the position of assistant manager of General Electric Lamp Department's Pacific Sales District, has been made manager of that district. He succeeds M. C. Hixson who has retired.

On September 1, the Lamp Department of G-E discontinued its Nela Specialty Division, 1 Newark Street, Hoboken, N. J. The sale of G-E glow lamps and sodium lamps, which the division has handled in the past, will be handled in the future by other Lamp Department sales districts throughout the country. Charles F. Strebig, manager of the Nela Specialty Division since it was formed in 1939, has been transferred to the Lamp Department's headquarters, Nela Park, Cleveland. H. R. Waker has been transferred to the Atlantic Sales District and W. W. Becky to the Midland Sales District Chicago.

P. E. McCAUGHEY WITH FEDERAL

Patrick E. McCaughey has been appointed merchandising sales manager of Federal Electric Products Company, Inc., with headquarters in the executive offices at Newark. Mr. McCaughey was formerly manager of the National Adequate Wiring Bureau.

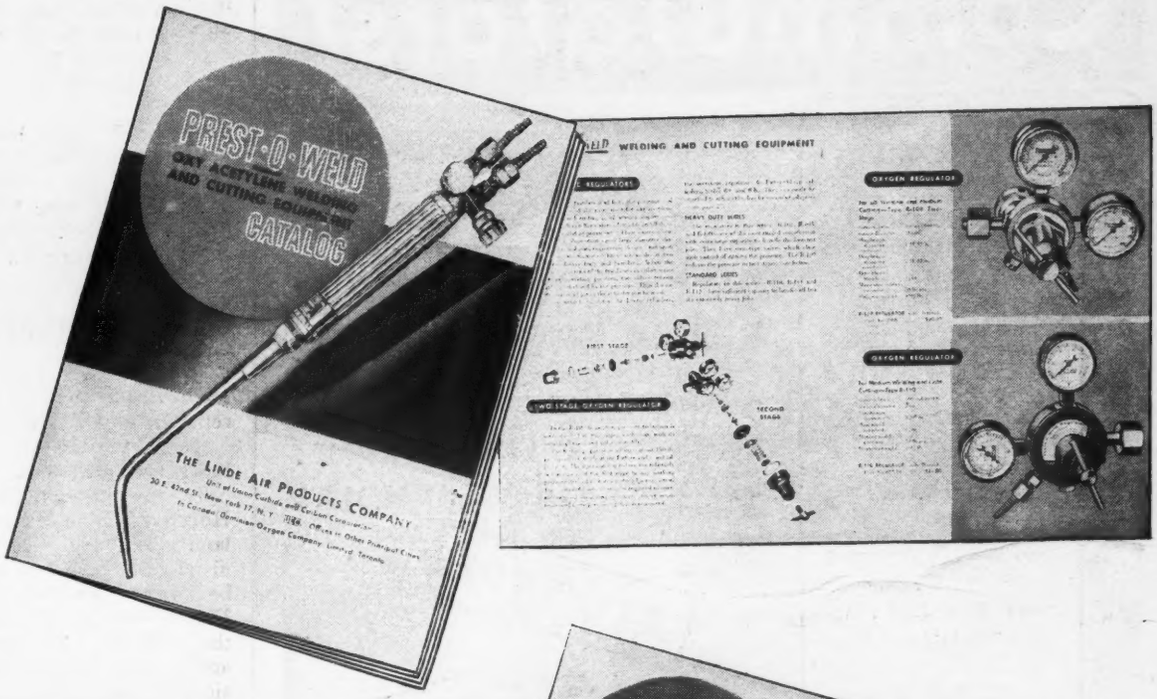
MOE-BRIDGES APPOINTS J. G. RAINEY SALES MANAGER

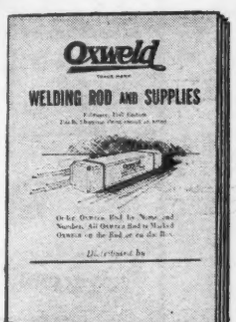
J. G. Rainey has been named sales manager of Moe-Bridges Corp., Sheboygan, Wis. Mr. Rainey, former merchandising executive with General Electric Co., will have charge of the merchandising program for the Moe-Bridges line of fluorescent lighting fixtures and electrical appliances.

ALLEN AND OLSEN HEAD NEW COMPANY

Clyde E. Allen and Robert E. Olsen have formed the Allen and Olsen Manufacturing Company, and will manufacture fluorescent lighting fixtures. The office and plant is located at 13452 West Washington Blvd., Venice, California. All products will be distributed through recognized wholesale channels.

You Should Have a Copy!





Here are the latest catalogs showing Linde's two outstanding lines of oxy-acetylene welding and cutting equipment available from jobbers everywhere. Each catalog has thirty pages . . . full color illustrations . . . all arranged for easy selection and ordering of just the equipment you need for your work. Ask your jobber or write direct to Linde for a copy of the PUROX or PREST-O-WELD catalog.

You also should have a copy of the OXWELD Welding Rods and Supply Price List. Ask for it, too.

The words "Oxweld," "Prest-O-Weld," and "Purox" are registered trademarks of Union Carbide and Carbon Corporation.

THE LINDE AIR PRODUCTS COMPANY

UNIT OF UNION CARBIDE AND CARBON CORPORATION

30 EAST 42nd STREET · NEW YORK 17 · N.Y. UCC OFFICES IN OTHER PRINCIPAL CITIES

IN CANADA: DOMINION OXYGEN COMPANY, LIMITED, TORONTO

Commutators!

FOR PROMPT SERVICE CONTACT YOUR NEAREST DISTRIBUTOR

DISTRIBUTORS CARRYING STOCK

INSULATION & WIRES INC.
3435 Choteau Ave.
St. Louis 3, Missouri
25 W. Broadway
New York 7, N. Y.
30 Trowbridge Ave.
Detroit 2, Michigan
1040 Tremont St.
Boston 2, Mass.
450 Bishop St. N. W.
Atlanta, Georgia
1111 Live Oak St.
Houston 3, Texas

TRI-STATE SUPPLY CORPORATION
318 Occidental Ave.
Seattle, Washington
544 S. San Pedro St.
Los Angeles, California
554 Bryant St.
San Francisco, Calif.

Sales by Representatives only

MANUFACTURERS SPECIALTIES, INC.
312 E. Wisconsin Ave.
Milwaukee 2, Wis.

A. J. ELLIS CO.
20 E. Jackson Blvd.
Chicago 4, Illinois

AVAILABLE
FROM STOCK...
REPAIR SHOPS...NOTE
A FACTOR OF PARAMOUNT IMPORTANCE WHEN PROMPT SERVICE IS ESSENTIAL

ALL TYPES
ALL SIZES
TO MEET YOUR REQUIREMENTS

SEND IN OLD CORES OF BOLT OR NUT TYPE CONSTRUCTION FOR REFILL

SPECIAL SIZES CAN BE MADE FROM YOUR SAMPLES OR SKETCHES

NEW CATALOG!
AVAILABLE
SEND FOR YOUR COPY
Lists Complete Dimensions of All Types of Commutators

THE KIRKWOOD COMMUTATOR CO.
1345 CARNEGIE AVE., CLEVELAND 15, OHIO

The KIRKWOOD COMMUTATOR Co.

Clyde E. Allen spent many years in the electrical appliance industry, including manufacturing and wholesale distribution in San Francisco. Two years ago he entered the lighting fixture business as general sales manager at the Mitchell Manufacturing Co. in Los Angeles.

Robert E. Olsen has been engaged in the manufacturing business in the Los Angeles area for the past 30 years. He recently left the Mitchell Manufacturing Company where he held the position of factory manager.

WESCO APPOINTMENTS

J. E. Conover has been appointed branch manager of the Brooklyn, N. Y. house of the Westinghouse Electric Supply Co. He succeeds Harry P. Neher, Jr., who has resigned. Prior to his appointment, Mr. Conover was Metropolitan apparatus and supplies manager.

R. E. Richards has been assigned to the duties of Reading, Pa. branch manager of Wesco. He succeeds the late S. B. Goforth. Mr. Richards was formerly assistant branch manager at Reading.

A. B. Darby has been appointed branch manager of the new Wesco house at 710 Front St., Boise, Idaho. He was formerly branch appliance manager at Salt Lake City.

MILLER ELECTED VICE PRESIDENT ACME ELECTRIC CORP.

The board of directors of Acme Electric Corporation of Cuba, New York, have elected Edward A. Miller to vice president, in charge of engineering. Mr. Miller joined the Acme organization in 1930.

FARADAY ELECTRIC PURCHASED BY SPERTI, INC.

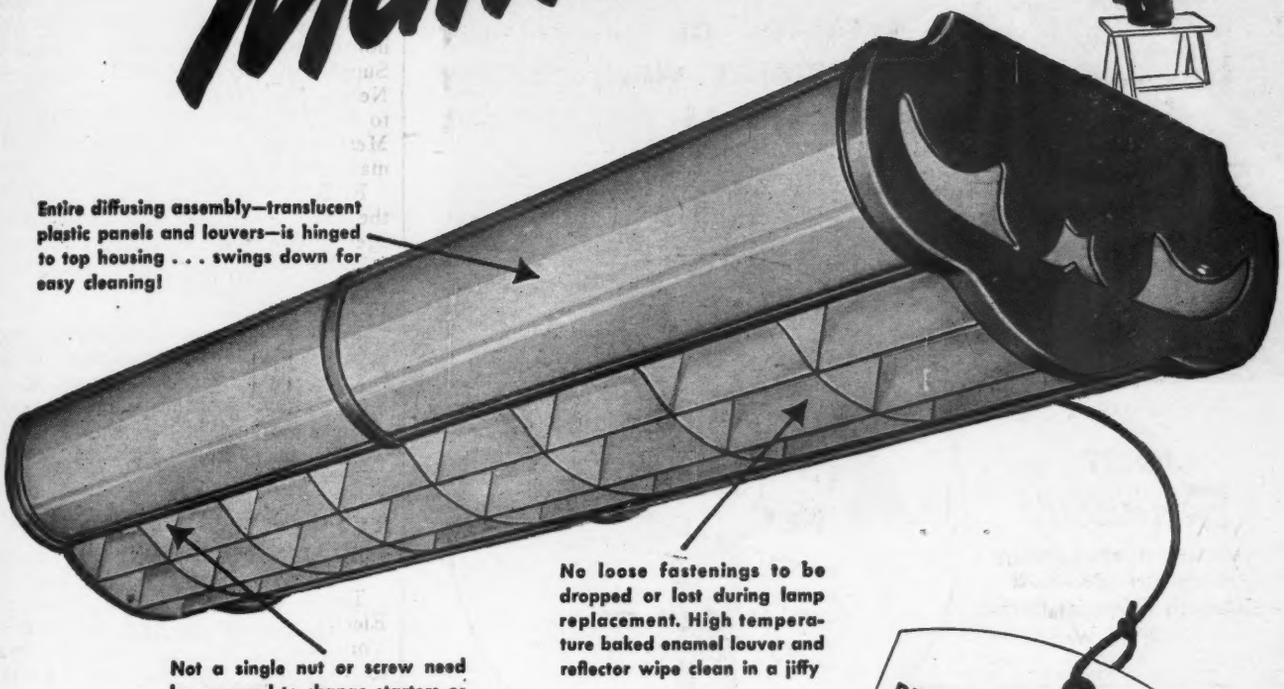
William H. Albers, chairman of the board of directors of Sperti, Incorporated, Cincinnati, Ohio, has announced the purchase of the Faraday Electric Corporation located at Adrian, Mich.

Heading up the new Sperti-Faraday subsidiary corporation is William H. Albers, chairman of the board; Ralph A. Lostro, president; Eugene Olson, vice president and treasurer. Lewis Stern will be general manager.

Accurate Manufacturing Co. of Garfield, N. J. has appointed James T. Heagarty of the Liberty Title & Trust Building, Philadelphia, as representative. His territory consists of eastern Pennsylvania, Washington, D. C. and the state of Maryland.

YOU'LL WANT TO HANDLE THE FLUORESCENT FIXTURES THAT ARE

Easiest to Maintain!



Entire diffusing assembly—translucent plastic panels and louvers—is hinged to top housing . . . swings down for easy cleaning!

No loose fastenings to be dropped or lost during lamp replacement. High temperature baked enamel louver and reflector wipe clean in a jiffy

Not a single nut or screw need be removed to change starters or 4 40-watt lamps!

REMEMBER ALL LAMPS IN SYLVANIA FIXTURES ARE SYLVANIA-MADE... THEREFORE OF THE HIGHEST QUALITY

They have rugged qualities, brilliance and refinements that far surpass the standards of the most critical buyers.

Here's the C-205, 200-watt *completely* Sylvania-guaranteed fixture. Typical of all Sylvania fixtures, it's extremely easy to install and maintain — quick simplified maintenance means a great saving in time and money for you!

Styling that sells itself is built into every fixture. One reason the C-205 is ideal for *every type* of store — chain, variety, department.

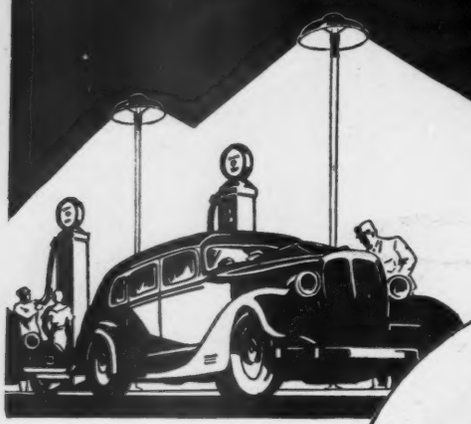
Assure your customers of the tops in engineering and quality — and make it more profitable for you by selling them fixtures easiest to maintain, simplest to install! *Sylvania Electric Products Inc., 500 Fifth Ave., New York 18, N.Y.*

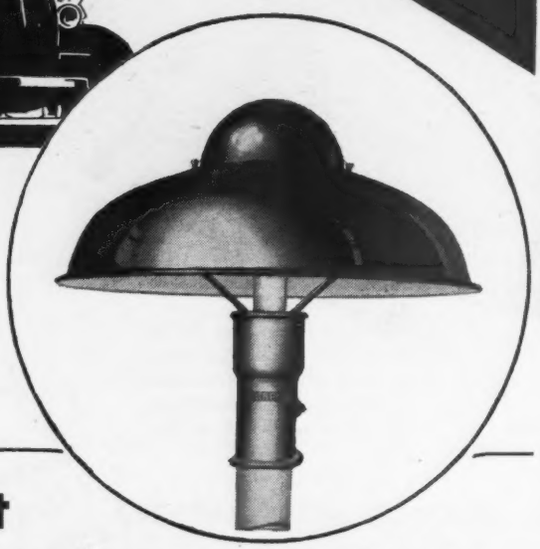
SYLVANIA ELECTRIC

"Fluorescent at its Finest!"

FOR OFFICE, STORE, HOME, FACTORY

GOODRICH STANDLITES





No. 77
Standlite
FINISHED IN PERMANENT PORCELAIN ENAMEL— ENTIRELY WEATHERPROOF

A Standout for close-up illumination

IT'S easy to see why the Goodrich Standlite is first choice among gasoline service stations everywhere.

Here's the high efficiency, high intensity illumination that means better light for busy places! Greater efficiency results from lamp in base down position, utilizing the entire reflecting surface—diffusing light over a wide area — minimizing glare. Low mounting height brings light closer to the ground—makes for easier installation, easier servicing. Simple, attractive design adds a modern touch wherever it's installed.

The Standlite is only one of the hundreds of styles and sizes of Goodrich fixtures for indoor and outdoor illumination. Write for literature.

RLM

Sold Through Electrical Wholesalers

GOODRICH
ELECTRIC COMPANY
4600 BELLE PLAINE AVENUE, CHICAGO 41, ILLINOIS

Essex Wire Corporation of California is expanding its manufacturing facilities at the Anaheim, Calif., plant. This will enable the corporation to produce a complete line of wires and cables on the Pacific Coast.

It is also intended to have a **Paranite Wire and Cable Division** of the Essex Wire Corporation of California. This division will manufacture and sell wires and cables for distribution through electrical wholesalers.

•

Leader Electric Co., Chicago, has moved to its recently completed new home at 3500 North Kedzie Avenue. The present size is 50,000 square feet, with a similar addition planned for the near future.

•

The Edwin F. Guth Company, St. Louis, has announced the appointment of Oscar Hogenson as representative in Northern Idaho, Oregon and Washington. Mr. Hogenson's office is at 95 Connecticut Street, Seattle, Wash.

•

Cutler-Hammer, Inc., Milwaukee has opened a new branch sales office at 107 North Franklin Street, Saginaw, Mich. R. L. Hibbard will manage the new office as a branch of the company's Detroit District Sales Office.

•

Ward Leonard Electric Co., Mount Vernon, N. Y. announces the appointment of Durling Electric Company, 2002 St. Paul Street, Baltimore, Md. as representative in Virginia, south central Pennsylvania, Maryland, except for the Washington area, and Delaware south of Wilmington.

•

Frederick A. Meyer has been named representative of the **Burlington Instrument Company,** Burlington, Iowa. Mr. Meyer's headquarters will be at 207 East Michigan St., Milwaukee, Wis. and his territory includes the state of Wisconsin and the upper peninsula of Michigan.

•

The Narragansett Wire Co., Pawtucket, R. I. have appointed George R. Magnes of The Agencies Company, Pacific Coast representative. The Agencies Company has sales offices at 125 South Santa Fe Avenue, Los Angeles and at 420 Market Street, San Francisco.

•

Kurt Versen Company, Englewood, N. J. announces the appointment of Bernard McRonald as general sales manager. He was formerly midwestern sales manager of Wabash Corporation.

THIS

OR THIS?

FRANCE
INSTA-START
REG. U. S. PAT. OFF.
TRANSFORMER
The Keystone of Fluorescent Lighting

MODERN Fluorescent Must Have Instant Starting

● With instant starting and the elimination of the separate starter, hot cathode becomes truly modern fluorescent lighting, and hence more widely applicable. Instant starting is especially desirable in homes. France INSTA-START Transformer, manufactured since 1941 and steadily improved in design, is now available for two 30, two 40 or two 100 watt lamps, with power factor approximately 95% or better. Smaller dimensions, reduced weight and new shaped case permit easier installation or replacement in 90% of today's hot cathode fixtures. Write for circular.

THE FRANCE MANUFACTURING COMPANY
10325 BEREA ROAD CLEVELAND 2, OHIO

Armstrong Control Co., 8816 S. E. 17th St., Portland 2, Oregon

Allanson Armature Mfg. Co., Ltd., 21 McCaul St., Toronto 28, Canada

something NEW in tool belts

"KLEIN-LINE" TOOL BELT with the sliding trace

The "Klein Line" Tool Belt—new in design—provides increased comfort and convenience and a maximum factor of safety to the lineman.

The distinctive feature of this new belt is the Sliding Trace. Made of "Klein-Kord" (the same proved material used in our safety straps), the Sliding Trace is mounted on the cushion and carries the drop-forged tested single bar Dee rings. The trace slides freely through alloy steel guides, allowing movement of approximately 6 inches in either direction. Thus, the lineman is relieved of chafing often caused by conventional belts, and undue safety strap wear is prevented.

Other construction features of the new "Klein-Line" Belt include: 2-inch wide heavy harness leather belt strap with drop-forged buckle; 1-inch wide harness leather tool loop strap securely riveted to the main strap; and 4½-inch wide cushion of pliable latigo leather with rolled edges and canvas interlining. All sewing is lock stitched with hot waxed linen thread—all rivets solid copper hand set. Furnished complete with plier pocket, tape thong and knife snap.

Ask Your Supplier

Foreign Distributor: International Standard Electric Corp., New York

A copy of the Klein Pocket Tool Guide, showing the Klein line and containing valuable tool information, will be sent on request.

Mathias Established 1857 **KLEIN** & Sons Chicago, Ill., U.S.A.

3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

Preston M. Postlethwaite has been appointed manager of both electrical and automotive divisions of the **Wagner Electric Corporation** branch at Portland, Oregon.

•

Electric Machinery Mfg. Company, Minneapolis, Minn., announces the establishment of a new sales office in Dallas, Texas, at 2023 Jackson Street. H. L. Renking, formerly manager of the Pittsburgh office, is in charge.

•

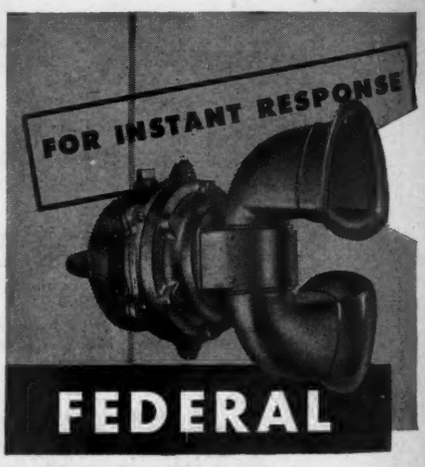
Rockbestos Products Corporation of New Haven, Conn., has opened new offices and warehouse at 3100 East 10th Street, Oakland, Calif., with Philip O. Weston, district manager of the Pacific Coast territory in charge.

•

Kinsey Electric Company, manufacturers of transformers, has opened a plant at Fairburn, Ga.

•

Morris G. Munson has been appointed manager of the unit ventilator division of the **Herman Nelson Corporation,** Moline, Ill.



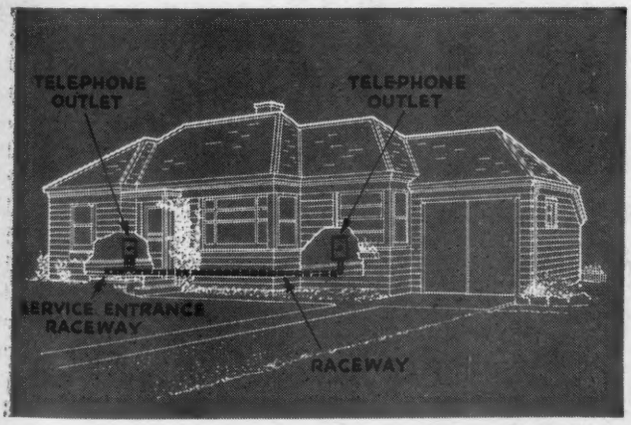
Industrial Horns

electric or air actuated, will solve your signalling problems. Easily installed, these powerful, penetrating signals have a quick cut-off, may be coded to convey a variety of messages. Built to live in industrial locations, weather and water proof; heavy construction of corrosion proof metal insures long life, dependable operation.

FEDERAL ELECTRIC CO., INC.
8726 S. STATE STREET
CHICAGO 19, ILLINOIS

Bertram Weber, Architect

THIS SPICK-AND-SPAN MODERN HAS A RACEWAY FOR TELEPHONE WIRES



Conveniences are important in small homes as well as large. Certainly raceways for concealing telephone wires belong in every contract. And you and the homeowner both gain from their inclusion.

Telephone raceways can be installed easily while construction is going on. A few pieces of pipe or electrical tubing are often enough to provide a clear passage for telephone wires through outside and interior walls to convenient pre-planned telephone outlet locations.

REMEMBER—*No electrical contract is really complete unless it includes raceways for telephone wiring facilities.*

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GUARANTEED 50% LONGER

RELIANCE AUTOMATIC LIGHTING CO.

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"Model-W" synchronous Automatic Switches.

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for consumer protection and increased profits

WITH NEW

NO-SHOK

CONVENIENCE OUTLET!

Promote SAFETY—prevent loss of life—with this accident-proof, heavy duty, NO-SHOK duplex receptacle. With its positive snap-back spring action, face is closed tight when plug is removed, thus assuring children and adults full protection from electric shock against which ordinary outlets cannot guard. Play safe—build sales, good will, and prevent tragic accidents.

Thick double walls of bakelite separating and insulating heavy duty terminals —lifetime spring action— firmer plug grasp, positive contact always.

Listed as Standard by Underwriters Laboratories

Belco PRODUCT

BELL ELECTRIC COMPANY

CHICAGO 8, ILLINOIS

CONVERTIBLE SLIMLINE

[FROM PAGE 61]

imposed by the 25-ft. bay, allowances for partitions and size of new sockets combined to make dimensions a design criterion. Brooker engineers tackled the problem and designed their own fixture channel and lamp socket on which a patent is now pending.

Outstanding features of the channel are its roominess despite the 5-in. maximum width; four ventilating louvers at each ballast location; and the pressed counter-sunk holes to accommodate bolts for mounting ballasts. This latter feature provides an air space between the channel and back of ballast thus adding to the cooling possibilities. Full removable covers expose the entire channel for wiring installation and maintenance. Although the preliminary fixture layout required some 43 different channel lengths, rearrangement and combinations finally reduced this figure to 17.

With the complete channel weighing about five pounds per lineal foot, adequate supporting features were important. Each section of channel is mounted to a 1½-in. by 1½-in. angle iron running its entire length and resting on the suspended ceiling steelwork. A standard 16-foot section of channel is supported by four 5/16-in. bolt rods and a standard outlet box mounted to the angle iron.

To provide the desired lamp interchange feature, special sockets were designed that would accommodate the various types of hot and cold cathode lamps, of comparable length, now being produced. A pair of plastic open circuit spring lampholders differing in length and internal construction were developed. The circuit closing, or "short" socket, has an overall length of 1¾ inches with a ¼-inch travel before making contact. The second, or "long" socket, is 3-inches long and has a 1½-inch lamp travel to take care of the slight difference in length between types of tubes Both are equipped with sturdy copper cups which seat the various types of lamp ends. In the "long" socket the spring provides tension and also makes contact with the terminal; in the "short" socket, it is insulated from the contact bar and provides tension only. Lamp pins protrude through a ¼-inch hole.

Study of the photo of the sockets and circuit diagram will show the safety features incorporated. Removing a lamp breaks the circuit and no shock could be experienced unless direct contact is made with the interior

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Only these pliers incorporate the exclusive Channellock tongue and groove joint. This patented joint is far superior to the conventional type of adjustable pliers for these reasons:

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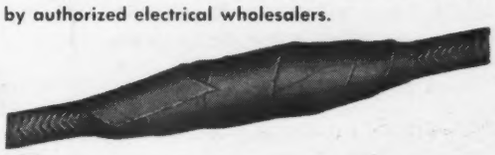

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TELLS YOU
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Whether it is A.C. or D.C.
Whether it is STAR or DELTA connected.
TESTS for FEED BACK OR GROUNDED CIRCUIT. Read the Instruction Sheet for Operation.

You can make any test with this instrument that can be made with any other Voltage Tester, but it has a wider range of usage than any other Voltage Tester known.

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A precision built instrument of established merit incorporating the following features—starting reliability coupled up with a fully automatic circuit breaker that will cut out a deactivated tube from the circuit—no manual reset required to allow starter to perform all of the lamp starting functions when a good lamp is installed. Contacts are made of noble metal assuring longevity, durability and economy.

You'll find Industrial Electronics Corporation products in factories, office buildings, stores, railroad terminals, shipyards, schoolrooms . . . everywhere contributing to the comforts of American Life.

The (SP-15-20) for use with either 15 or 20 watt lamps
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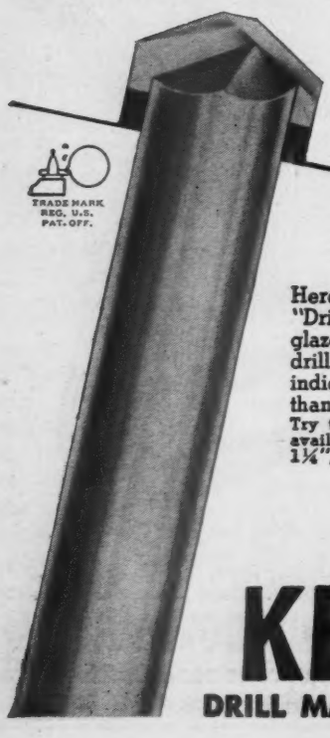
WORLD'S FASTEST MASONRY DRILL

BECAUSE THE CUTTING EDGE is KENNAMETAL



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Try them now—in any standard rotary electric drill. Sizes available: ¼", 5/16", 3/8", 7/16", ½", 9/16", 5/8", 11/16", ¾", 1", 1⅛", 1¼", and 1½".

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KENNADRILLS

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of the "short" lampholder. This is practically impossible. Should this occur, however, only a 125-volt to ground shock would ensue. To insert a lamp, one end is depressed into the "long" socket. Only when the opposite end is inserted into the "short" socket will a voltage be impressed across the lamp. Conversely, removing a lamp from the "short" socket breaks the ballast primary circuit.

Circuit wiring from panels to ballast primaries consists of No. 12, 600-volt conductors; from the secondaries to lampholders, No. 16, 750-volt stranded wires. Color coding of the ballast leads was maintained throughout.

The saw-tooth construction precluded wiring from bay to bay at right angles to the skylights. One or more narrow-type lighting distribution panels per bay are installed flush in the supporting columns. Each panel, serving three or four paralleling bays, has a single-phase air circuit breaker main disconnect at its base.

Ballasts of this type frequently cause excessive arcing at local wall switches due to reactive inductance. To minimize this, a maximum of four ballasts (eight lamps) were connected per ten ampere switch. In most cases alternate pairs of lamps controlled by one switch provides two levels of lighting.

An example of special conditions encountered is a showroom area where 90 to 100 footcandle intensity was desired. This 3300 sq. ft. area is illuminated by 704 93-inch lamps spaced on 6⅛ inch centers and mounted four inches below the plaster ceiling. A full frosted-glass ceiling suspended 28 inches below the flat plaster ceiling conceals the units. To accommodate the short spacing of the lamps, special 7-in. by 7-in. channel was designed. The area is divided into two equal parts, each being provided with three levels of illumination. Momentary contact pushbuttons, operating contactors in the lighting panels, provide 50, 75 or 100 percent initial intensity.

Generally speaking, this lighting installation has been more than satisfactory. Illumination levels at the working plane are uniform. Looking north on the second floor (toward skylights) the lamps are completely hidden from view; looking south, with eyes above the horizontal, the few lamps visible do not "stack up".

In the first floor area, some "stack up" is apparent when one looks beyond three bays (at right angles to lamps). When and if this condition becomes objectionable, it can be minimized by suspending baffles from the ceiling at the column lines.